Performance of Million-Volt Transformer — ***Opportunities for the Young Electrical Engineer, Oscillograph for Demonstrating Voice Waves, and Other Articles***

Electrical World

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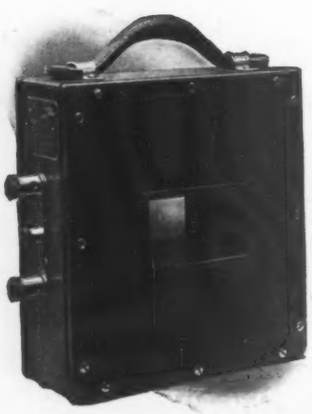

The full line of new Weston Portable Instrument Transformers, including the three illustrated here, is described in Bulletin 2001.

Electrical World

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Thomas A. Edison—Illuminating Engineer

ONCE more the man of the electrical industry best known to the hundred millions of a nation has been publicly presented with a testimonial of the esteem in which he is justly held by the men within the industry. The Illuminating Engineering Society in presenting to Thomas Alva Edison an honorary membership honor themselves as well as the modest man who smilingly bowed his acknowledgments to the gathering of the leaders in the electrical industry assembled on this occasion. Mr. Edison has received many deserved honors. Recognized as the father of the electric-lighting industry because of his indefatigable researches not alone in finding and making a commercial incandescent filament lamp, but as well in conceiving and arranging electrical machinery into a system of distributing electricity which made the practical use of the lamp possible, his name is also coupled with vitally significant discoveries in the realm of physics and chemistry and the application of these discoveries to the uses of mankind. Withal he has kept his humanness and his common-sense perception of those qualities of simplicity and singleness of purpose which have endeared him not only to the men who have been associated with him but to that majority of the public which estimates him chiefly, as it estimates all men, on these human qualities of greatness. For Edison belongs in that group of great, simple men of whom John A. Brashear and John Burroughs in other walks of science are representative. Neither honors nor public acclaim can take from such men the greatness of their simplicity.

Efficiency in the Patent Office

OUR system contemplates granting patents only for inventions which by examination have been ascertained to be new and useful. The examination should be painstaking and thorough, because the proper limitation of patents by full examination before grant is vastly important. An inventor may obtain a patent that is broader than is warranted whenever through handicap or inefficiency the Patent Office is unable to study the matter exhaustively, and society in general loses. Hence the necessity of an ample examining force and of closer scrutiny of the claims of patentees. The business of the Patent Office is larger to-day than it has ever been and involves more work and skill in separating the wheat from the chaff. Notwithstanding this handicap, however, the commissioner of patents has managed to give a good account of his office. It is therefore pleasant to record that owing to his efforts Congress has at last made provision for the reorganization of the Patent Office and for an increase in the examining board. These changes and increases will aid in carrying out administrative reforms which have been instituted with a view to unification of practice and to more rapid and satisfactory disposition of the business of the office. Every increase in Patent Office efficiency effects, by better searches and fuller consideration, a decrease in the issuance of patents that are too broad or are entirely unwarranted. It has been very well stated that no like number of men in the world assembled in one body has to perform duties as delicate and difficult as those which are performed by the members of the examining corps of the Patent Office. They delve deeply into every science and art and the search increases with expansion of the field; they administer the registration of trademarks; they answer all appeals from their decisions against applications; they determine all interferences between rival applicants, and they do other valuable work which need not be here cited.

The present commissioner has striven to raise the Patent Office to the dignity and efficiency which its great public function demands, and if proper appreciation were accorded the Patent Office and the principles for which it stands, the accumulated learning of all the arts would be classified and disseminated, inventors would be instructed, stimulated and rewarded, and the public also would be protected. However, until now aid has been withheld. The office has been swamped with work, and one of the prime objects of the patent law has been defeated because of inadequate forces to carry out its spirit. The function of the Patent Office is to prevent the granting of patents which should not be granted, and any insufficiency of provision for its work results inevitably in improperly granting patents, with consequent burden upon the public and inventor alike. Hence it is reasonable to expect that with the provisions just made the work will be performed more efficiently.

Investigating the Nature of Speech

ANY reasonably complete theory of the electrical and acoustic actions of the ordinary telephone transmitter and receiver system must necessarily include as an element some theory of the acoustics of speech. There are two principal acoustic theories of speech. One assumes that the ear analyzes each and every received sound into its Fourier components, and when certain groups of these components are found to exist simultaneously a certain corresponding consonant or vowel sound is recognized by the brain of the listener. The

other assumes that each and every sound has a certain resultant acoustic wave-form, and that the ear recognizes this wave-form and conveys the impression of the corresponding consonant or vowel sound to the brain. The former may be called the analytic and the latter the synthetic theory. The synthetic theory has this consideration in its favor, that the listener has no consciousness of exerting any analytic process. A certain wave-form causes his eardrum to vibrate in consonance, and a certain auditory impression forms correspondingly in his consciousness. On the other hand, musicians have demonstrated many times that the trained ear can detect a given component tone, among a medley of components, in a complex musical note, thus showing that the mechanism for analysis exists in the ear, whether it produces a conscious effect or not. It is possible to find arguments in favor of both these theories. In fact, so much evidence has been presented on both sides that it would seem as if both theories were right and as if neither theory alone would be able to meet all the conditions. That is, it seems as though the ear and its mechanism were influenced both by the synthetic wave-form and also by some of the analytical components. The paper by John B. Flowers on "The True Nature of Speech," recently read before the American Institute of Electrical Engineers, emphasizes the synthetic theory by some interesting experimental evidence. It purports to show that when the amplitude of vocal vibration varies over a certain contour, for a certain interval of time, a certain corresponding sound is recognized by the brain through the receiving ear. The amplitude contours are compared, in a general way, with those of siphon-recorder signals as received over a submarine cable. It is, of course, understood that such signals are associated with a particular speed of signaling over a cable of a particular time constant; because, if either the speed of signaling or the *CR* time constant of the cable were considerably changed, the corresponding siphon-recorder signal contours might be profoundly modified. While admitting the force of the experimental evidence on behalf of the synthetic theory presented in the paper, it must be borne in mind that experiments have demonstrated that the phase relations of component notes in a complex tone do not appreciably affect the auditory impression produced by the tone. Thus, a given instantaneous wave-form of a complex musical note impressed on a telephone transmitter diaphragm might produce a very appreciable difference in the wave-form of two receiving telephones in the same circuit, one close by the transmitter and the other electrically remote, owing to the difference in speed of propagation of electric waves of different frequency, and yet the ear of a listener would be able to recognize the same tone in each receiver. Consequently, the shape of the received acoustic wave-form, so far as depends upon the relative phases of the component tones, does not seem to affect the sensation of the received sound. It will be very interesting to learn whether the voice-operated phonographic machine which Mr. Flowers has developed will, when completed, enable trained observers to read the recorded phonographs.

Using Sector Cable in Existing Duct Lines

ENGINEERING investigations on ways and means for accommodating the growth of feeder systems in existing duct lines without increasing the operating voltage have formed no small part of the studies made by metropolitan companies to handle increasing loads on their generating stations economically. The problem has resolved itself into finding methods of placing conductors of greater carrying capacity or lower resistance in cables of the same outside diameter. To accomplish this where multiple-conductor cables are involved room has been made for large conductors by reducing the thickness of insulation or by assembling the conductors in a more compact form. The first method leads to grading of the insulation—that is, using two or more layers of insulation of different specific values with the view of equalizing the dielectric stress radically and thereby eliminating dangerous stresses at the surfaces of the conductors. The second method leads to conductors of sector or nearly sector form, which may be assembled in considerably less space than cylindrical conductors of equal cross-sectional area, and such cables solve the space problem far more satisfactorily than graded cables for potentials up to about 25,000 volts, three-phase. Beyond this voltage it is not improbable that the comparatively sharp corners of the sector-shaped conductors may cause excessive dielectric stresses, in which case resort will be had to grading. Quite another consideration has also led to the use of sector cables where no space restrictions exist, namely, economy of lead sheathing.

Both sector and graded cables were in extensive use in Europe several years before anything but experimental work had been done on them in America. Considerations of economy apart from space restrictions led to their adoption, as duct lines are but little used in Europe for power cables. The economy attained by the use of sector cables abroad was greater than it would be here owing to the use of armored cables laid in the ground without ducts, the saving being not only on the cost of sheath but also on that of armor wire. The voltage limit of sector cables appears to have been reached in some of the European installations, as reports of excessive dielectric stresses at the points of the sector conductors have been received from Germany. The sector cable has been admirably developed in this country and is now thoroughly practicable for potentials of at least 25,000 volts, three-phase. As now used, the conductors are stranded concentrically in the ordinary way and the cylindrical cable is drawn into sector shape by passing through a die. In other cases wires of different sizes are stranded directly into the sector shape without passing through a die, special machinery being required for the purpose.

Particular interest attaches to the subject at the present time since several large companies have decided to adopt sector cables on a large scale. A notable case is that of the Interborough Rapid Transit Company, which will use 11,000-volt and 19,000-volt, three-phase, paper-insulated sector cables for the subway lines in New York City now under construction. An

article in this issue presents interesting comparative data on sector and round-conductor cables used by other companies. These data clearly show the reasons which have led to the frequent adoption of the former type by companies engaged in construction on a large scale.

Closing a Gap Between Science and Practice

AS scientific men and engineers we sometimes talk too much among ourselves and too little for the benefit of those to whom our special knowledge is most useful. Among ourselves we refine discussion. We go into intimate scientific detail. We fill our transactions with much learned terminology. We discuss and dispute definitions that should properly be discussed and disputed. And do we not sometimes forget what it's all about? It seems unfair to pin the accusation of forgetting its opportunities to an association that has made real and effective progress in its work and whose meetings are noteworthy for large attendance and worth-while scientific and practical discussion. Yet the very fact that the science and art of illumination have a practical every-day and every-night application in thousands of stores, homes and workshops makes the need very real for closing the gap between scientific discussion and common practice. It is fair to say that the fixture manufacturer and the local fixture houses have more to say about how houses of the country are to be lighted than the engineers. While we discuss light intensities and methods of measurement, the fixture man fills orders for brushed-brass colonial side lights, shower lamps for the family dining table, and inverted bowls for the living-room. The local contractor, following the architect's lead, puts in outlets with mathematical exactness as to centering but with a generous disregard of where the shadows fall. How many kitchens are there, for example, where the housewife or the maid can stand at the sink, stove or table without being always in her own light? One householder had to have his kitchen ceiling outlet moved back twice after designating an off-center location to obviate this simple difficulty because the wiring contractor always had put outlets in the center of the ceiling and was very determined that there was where they belonged. This editorial, let us emphasize again, is not in criticism of an association for whose admirable work the writer has deep appreciation. If it will suggest the possibility of interpreting the scientific for the benefit of the every-day user, its purpose is accomplished. That such work needs to be done many members of the association have already stated. That much has been done is also known, and that very much more may be done this journal is equally sure.

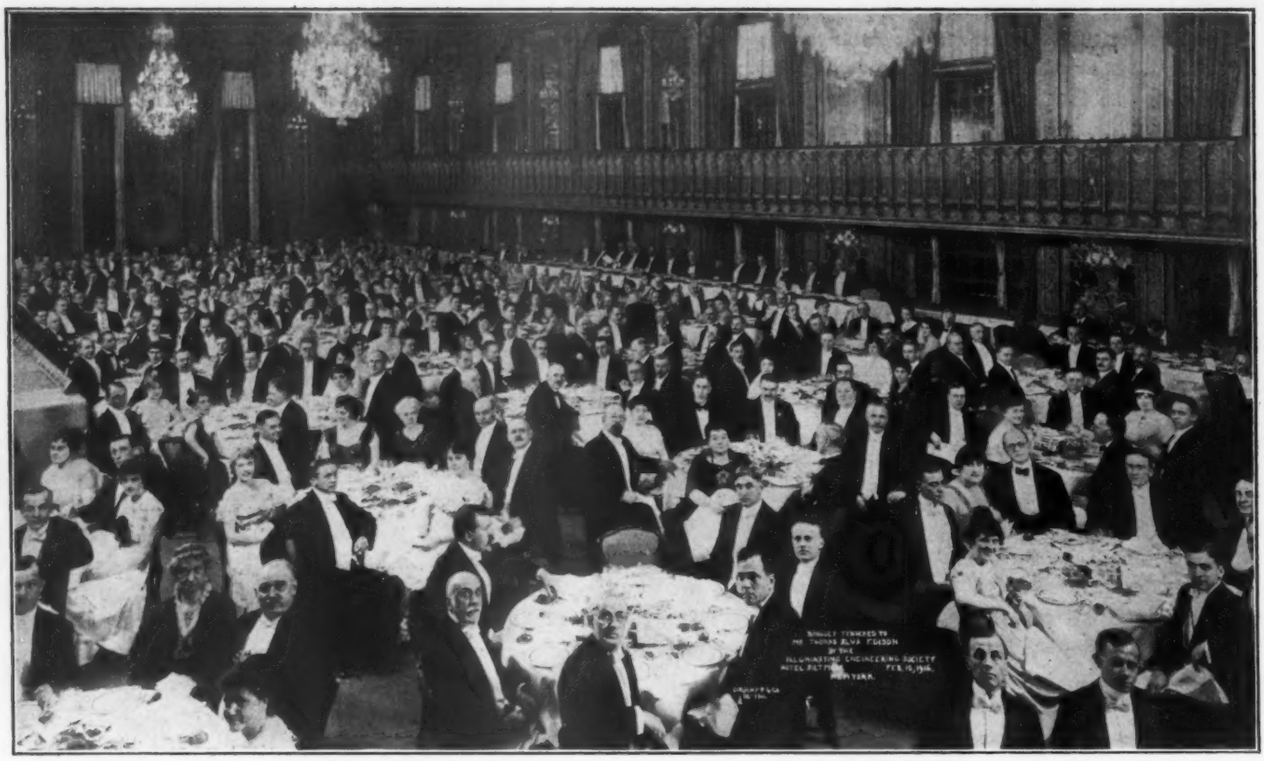
Glass Reflectors in Industrial Plants

THE use of metal reflectors of white-enamel or aluminum finish has been recommended so widely for factory and industrial plant lighting with tungsten lamps that it sometimes seems that the possibility or plausibility of using anything except a metal reflector in factories has completely escaped notice. The writer believes this tendency is to be deplored. That there is such a tendency was recently well illustrated at a meeting held for the purpose of instructing factory managers and "safety-first" men in proper methods of artificial lighting. At this meeting nothing whatever was said about the possibility or advisability of using the tungsten lamp in anything but a metal reflector in a factory. For a large number of locations in industrial plants translucent reflectors as well as opaque metal reflectors should be considered. Translucent glass reflectors are preferable in locations where the ceilings and walls are not so dark and dirty as to render ineffective any light which may be directed upward or horizontally. There is likely to be little difference in working-plane efficiency between a good translucent dense opal reflector and an opaque metal reflector. The metal reflector has the distinct disadvantage that the ceilings and upper walls are less bright than where a translucent opal reflector is adopted. The shop is therefore not so cheerful at night. Moreover, greater contrasts are presented to the eye, and hence there is more eye strain. There is less diffused light and the shadows are sharper. All of these disadvantages are many times undergone for the sole purpose of saving a negligible amount in reflector breakage. To be sure, there are locations where a metal reflector helps to protect the lamp and also presents an unbreakable surface itself. However, most locations where an incandescent lamp can be placed are safe for a glass reflector. If the danger of falling glass is too great, a detachable network is easy to apply. Glass is more easily cleaned than white-enameled metal, the theories of many salesmen and factory superintendents to the contrary notwithstanding. To keep down maintenance and cleaning expense, however, glass reflectors in industrial plants should usually be perfectly smooth inside and out, without ornament or corrugations.

The Coming Issues

NEXT week's issue is the commercial number of the month — the fourth issue of February—in which special emphasis is placed on selling plans and methods for widening the use and applications of electric service and electrical appliances. A leading article will point out how the electrical business man may use the newspapers to instill in the minds of his local public a better understanding of and appreciation of the utilities and their service. Other articles planned for that issue tell details of successful sales campaigns for the introduction of appliances, signs, house-wiring, etc. The story of how the electrical interests in an Eastern city were brought from discord into harmony will, in particular, interest dealer, contractor and central station alike. An unusual piece of church-interior lighting will be the subject of an illustrated article in this number.

The March 4 issue is the public-relations issue of that month, and will be followed in succession by the station-operation issue, March 11, and the engineering and technical issue, March 18.



BANQUET TO T. A. EDISON AT WHICH HONORARY MEMBERSHIP IN ILLUMINATING ENGINEERING SOCIETY WAS CONFERRED ON HIM

Chronicle of Events of the Industry and of Important Movements in the Field

NEWS OF THE WEEK

Reports of Conventions and Meetings of Electrical Associations and Societies

Electrical Jobbers Discuss Broad Business Problems at Detroit Meeting

During the first two days of the Electrical Supply Jobbers' Association meeting at Detroit, Feb. 15, 16 and 17, the Central and Atlantic divisions of the association held business meetings, and the association as a whole joined in one open session and two executive meetings.

At the meeting of the Central Division Arthur S. Selzer, sales manager of the Central Electric Company of Chicago, was elected division chairman to succeed N. G. Harvey of the Illinois Electric Supply Company, Chicago. The following members of the executive committee were also elected from the Central Division: W. R. Herstein, Memphis; W. W. Low, Chicago; N. G. Harvey, Chicago; F. M. Bernardin, Kansas City; Charles Scudder, St. Louis; F. D. Van Winkle, Cincinnati, and B. B. Downs, St. Paul. It was further decided that the members of the Central Division should hold a meeting during the latter part of April, the place to be selected by the general secretary, Franklin Overbaugh.

The Atlantic Division re-elected F. S. Price of Boston as its chairman and appointed the following members of the executive committee: E. C. Graham, Washington, D. C.; G. L. Patterson, New York City; H. L. Gorky, Syracuse; F. R. Elliott, Philadelphia; W. A. Dalrymple, Pittsburgh; F. S. Price, Boston, and W. L. Adams, Providence. E. W. Rockafellow of New York was recommended as executive committeeman at large by both divisions, and was later elected at the first general association meeting. The Atlantic Division will hold its meeting late in March.

Reports of Committees

Much of the time of the first two days' meetings was given over to reports of committees. Among these the reports of the central-station committee and the standard-package committee were of special interest. Speaking for the committee which had represented the Jobbers' association at the meeting of the United States Chamber of Commerce, E. C. Graham of Washington said he now realized more than ever the great work the United States Chamber of Commerce is doing. It now has 711 organizations as members and represents more than 300,000 firms. It is, he said, one of the country's greatest molders of public opinion. He advised that all jobbers follow its activities and take a live interest in the broad business problems of the nation. Only by looking into other industries can jobbers conceive new ideas helpful in their own business.

Following the reading of a letter from J. M. Wakeman, general manager of the Society for Electrical Development, Inc., the association's general secretary, Franklin Overbaugh, was instructed to appoint two jobbers as members of the committee on the Society for Electrical Development. On this committee, which will consist of nine men, it is planned that all branches of the industry shall be represented.

At the opening meeting Wednesday afternoon W. M. Lewis of Chicago, representing the Navy League, spoke on "Preparedness."

H. W. Alexander of the Society for Electrical Devel-

opment, Inc., outlined the plans of that organization for future work and pointed out ways in which it might aid the electrical jobber. W. W. Low spoke on "Co-operation," presenting a strong plea for honesty and business integrity on the part of jobbers and manufacturers.

The next meeting of the Jobbers' association will be held during June.

Edison Honored by Illuminating Engineers

On Its Tenth Anniversary the Illuminating Engineering Society Invites Inventor to Become Its First Honorary Member

The tenth anniversary of the Illuminating Engineering Society was fittingly celebrated by a midwinter convention held in New York at the Engineering Societies Building on Thursday and Friday of last week. The opening session, which was presided over by Arthur Williams of the New York Edison Company, was featured by a number of excellent addresses. John Purroy Mitchel, Mayor of the city, welcomed the convention, and his address was responded to by Dr. A. E. Kennelly of Harvard University, past-president of the I. E. S. Following these preliminaries, Dr. C. P. Steinmetz, president of the society, delivered an address on "Illuminating Engineering." He said that five years ago illuminating engineering was established as a recognized branch of engineering through a course of lectures given by the Illuminating Engineering Society jointly with Johns Hopkins University. This fall another lecture course will be given by the society covering and bringing up to date the entire field of illuminating engineering. Embracing the sciences of physics, physiology and psychology, of the architect and decorator, of ophthalmology, hygiene, bacteriology and therapeutics, Dr. Steinmetz said the Illuminating Engineering Society is of importance to the engineer, the physiologist and the psychologist, to the architect and the decorator, to the ophthalmologist, the sanitarian and the physician. The further the design of a satisfactory illumination leads up from applied physics into physiology and psychology, the more naturally the human element dominates and the more the success of the illumination depends not on light flux and its distribution but on the condition of the human being using the illumination.

Psychology of Illumination

L. B. Marks, the first president of the Illuminating Engineering Society, delivered an address on the "Tenth Anniversary of the Society." It was followed by an address by Prof. Hugo Münsterberg, the eminent psychologist of Harvard University. Speaking on the purely utilitarian side of illuminating engineering, Professor Münsterberg said that as yet "we know far too little how the working man profits from changes in the illumination where he is working. Some of the scientific management engineers have secured marked improvements in certain mills by altering the position of the light or the station of the worker with reference to the window, the intensity of the light or its diffusion. Yet all this has been attained by mere trying." The psychologist, however, has approached the field with regard to different color effects and different intensities of light and finds subjects whose mental processes take 20 per cent more time under the influence of red and others whose memory work shows an unusual improvement under green light. The tapping activity shows the most uniform rate with green, is decidedly quicker with red and slower with blue. Arithmetical work is strongly improved by red in a less marked way by an increase of brightness. The colored lights which are felt as pleasant produce by no means more favorable conditions for working efficiencies than those which are felt as unpleasant. The industrial world, he maintained, will have to give keener attention to the conditions of

EDISON READING ENGROSSED HONORARY-MEMBERSHIP CERTIFICATE

light in the producing plants and will have to consult the psychologist at every step.

Experimental psychologists know that all illumination is made for mental consumption. "The physical standards alone are right when the current is to give heat, but when it is to give light not for photographing but for illuminating purposes the human mind alone can furnish the standard. Nothing reaches our eye which does not touch our whole personality. The visual impression is the starting point for a whole hierarchy of a mental reaction. Every practical situation in which we use light demands more from us than mere awareness of the visual stimulus; each time our perceptions and aperceptions, our feelings and our attentions, our imagination and our will are involved."

Two years ago, when his advice was sought with reference to street lighting Professor Münsterberg went on record as saying: "The mere possibility of visual discrimination does not insure comfort and still less safety on the street. The most essential point is to have an illumination by which the attention is kept vivid and all the mental functions alive. Fair chances to see are of small use if the pedestrian or the driver fall into a benumbed state in which his attention is dulled and in which his reactions are slow. Offhand, and without having carried on any experiments whatever, I should be inclined to say that a uniform illumination would be unfavorable for the attention." Subsequent experiments in the laboratory and in the street confirmed this opinion. Laboratory and street tests indicate that "the non-uniform light is more favorable for every type of tested mental activity."

Professor Münsterberg also said that the interior illumination, with its problems of direct and indirect light, is a specially fertile region for psychological study. Lamps which are not translucent and create a big blackness in the midst of the lighted ceiling would never have been used if the warning of the psychologist had been heeded.

Charles R. Lamb, architect, delivered an address showing to what extent that profession was indebted to the illuminating engineer for bringing out the beauty of architectural work by day and by night. Dr. F. Park Lewis, physiologist, spoke on the physiological aspect of illumination.

Banquet to Edison

The banquet tendered to Thomas A. Edison on the occasion of conferring honorary membership in the society, which was held at the Hotel Biltmore on Thursday evening, was a most brilliant affair. Prominent men from all branches of electrical engineering assembled to do homage to the great inventor. Dr. Steinmetz in his address said that Edison had done more than any other man in promoting the art and science of illuminating engineering. By the invention of the incandescent lamp he made it possible to convert night into day and extend the hours of daylight. "It is an age of intellectual giants who have created modern civilization almost within one generation. It is with the greatest pleasure that I greet here, as a member of our society, the greatest of these giants who have made the modern world—the genius Edison."

The presentation of honorary membership to Edison was made by J. W. Lieb of the New York Edison Company. He traced the history of electric lighting up to the time of the invention of the incandescent lamp and discussed at great length the merits of the invention of Edison as compared with the inventions of others striving to attain the same results. Mr. Edison, in accepting honorary membership, was represented by William H. Meadowcroft, who thanked the society in behalf of Mr. Edison for the honor conferred on him. T. C. Martin also paid a glowing tribute to the genius of Edison in a well-received speech.

Possibilities of Stage Lighting

In his paper on "The Possibilities of Stage Lighting," presented at the Thursday afternoon session, Bassett Jones, consulting engineer, New York City, emphasized his belief that light should be used as an adjunct to architectural and decorative design, taking care, however, to avoid the bizarre. In stage lighting the effects should be conceived as purely decorative and must be more or less conventionalized.

Taking up the proper use of footlamps, the author pointed out that such lamps should serve the purpose of relieving the contrast made by the pronounced facial shadows resulting from the overhead lamps. Footlamps should relieve this contrast but not reverse this condition of intensity. Usually in each scene there is a locus of action in the setting, and there the maximum of illumination is required, both from above and from below. This condition may require a sectional arrangement of footlamps, controlled in sections, and portable so that it may be concentrated at one side or the other. A continuous foot trough is neither necessary nor advantageous, in Mr. Jones' opinion. Rather should the "foots" be in the form of groups of two-lamp or three-lamp units, the groups being so arranged that they can be moved longitudinally from below and the maximum intensity directed at will.

Glare from the exposed footlamp filaments is also a source of trouble. This can be obviated by setting the filaments horizontally or nearly so and inclosing each lamp in a deep bowl-shaped metal reflector of the extensive type. At the Bandbox Theater, New York City, where Mr. Jones has made a number of interesting applications of advanced stage illumination, two unit groups are used, each group consisting of two 100-watt lamps in baked white-enamel reflectors, giving two colors—light blue and pale amber, or white and amber. Reference was also made to the reflector equipment designed by Mr. Jones and described in his article in the Electrical World, beginning July 31, 1915, on "Mobile Color and Stage Lighting." The illumination of the Venetian fête and ball given in 1914 by the Society of Ecole des Beaux Arts Architects; the "Ball of the Gods," an artistic embodiment of the mythology of India, Egypt and Greece, given by the same society on Feb. 11 of this year, and a pantomime, "Pierrot and the Rose, a Night in a Persian Garden," were described in detail by the author to illustrate the potentialities of illumination as an aid to the art of the stage.

The Relation of Lighting to Architectural Interiors

Prof. Morgan Brooks, in his paper on the relation between lighting and architecture (read in his absence by A. L. Powell), urged effective correlation between the design of an interior and its illumination. Methods were also indicated for lighting interiors with this object in view. An artistic feature of a house, such as an oil painting, a choice bit of furniture or a handsome stairway, may be emphasized by superior illumination, just as a masterpiece of sculpture in an art gallery is specially lighted. Care must be taken, however, that this does not result in an exaggerated theatrical spotlight effect. In placing light sources the designer must recall that not only is it a satisfaction to know whence light emanates but it is artistically pleasing to have illumination non-uniform. Indeed, non-uniformity is a neglected means of success in architectural appreciation by light. In the same way much artistic taste in the design and furnishing of a room is nullified by immoderate or by monotonous lighting.

When a room is completely lighted it is grasped at a glance and maintains no interest. If only the center table is illuminated, there is opportunity for the play of the imagination in the darker places, and the room appears larger. Given a concert hall that is unduly long, with a platform at one end and entrances at the other, if evenly lighted the first glance discloses the full length of the hall and the extreme distance to the platform from the rear.

Now, let the stage be overlighted, the center only moderately lighted, and let the rear, under the balcony, have an intermediate illumination. On entering, the stage is conspicuous and the middle portion of the hall loses a few rows of seats, bringing the rear seats decidedly nearer to the stage. A wide room will appear longer when the side walls are illuminated more brightly than the ends, which then recede. The effect is enhanced if the ceiling-wall line is somewhat indeterminate, as the eye judges not merely by illumination but also by geometrical outline. Experiments have shown that a difference of the order of 10 per cent may be produced in the apparent distance of a wall by altering its illumination.

Thomas Schofield, illuminating engineer for the Consolidated Gas Company, New York City, in collaboration with Clarence Law, illuminating engineer for the New York Edison Company, presented a paper describing the lighting of the new office building occupied by the foregoing companies. Results of tests on both gas and electrical equipment were submitted.

Computing Light Flux and Horizontal Illumination

The joint paper by W. E. Hodge and R. W. Chadbourne described a simplified method of computing the light flux from a lamp, using the latter's vertical distribution curve. The curve is divided into 10-deg. angles, and the flux is found for each angle by means of a special diagram constructed on a thin piece of

transparent celluloid. No calculation is required beyond simple addition. The diagram is also direct-reading for all candle-power curves, regardless of their scale. A simple method of finding horizontal illumination, involving only two simple slide-rule computations, was also described. Special curves from which this calculation can be made can be taken directly from the vertical distribution curve of the lamp without preliminary calculations.

CANDLE-POWER MEASUREMENTS OF SERIES GAS-FILLED LAMPS

To determine the reduction factor for the calculation of spherical candle-power from the mean horizontal candle-power, a number of 80-cp. series gas-filled lamps were compared when operating at the same temperature, 2825 deg. K. The spherical measurements were made by means of a 50-in. Ulbricht sphere, and the results obtained, as reproduced from the paper by R. C. Robinson, are tabulated below:

Filament Mounting	Mean Horizontal Cp.	Mean Horizontal W.p.c.	Spherical Cp.	Spherical W.p.c.	Reduction Factor
V-shaped	100.7	0.66	82.5	0.805	0.82
Vertical	126.8	0.595	93.7	0.805	0.74
Horizontal	93.5	0.82	95.2	0.800	1.01
Diagonal	122.0	0.635	95.2	0.815	0.78

During the discussion of this paper several voiced the opinion that, owing to the differences in the mean horizontal candle-powers of gas-filled lamps having practically the same spherical candle-powers, some scheme of rating other than that now employed should be introduced. Others contended that the differences are not so important as set forth in the author's paper. It was suggested that tests for ascertaining the operating temperatures of series gas-filled lamps be based on spherical candle-power.

AN "AVERAGE EYE" FOR HETEROCHROMATIC PHOTOMETRY

The comparison of lights of different colors is based on the "average normal eye." The paper by E. C. Crittenden and F. K. Richtmyer recorded an attempt to approximate the results of such an eye with typical color differences by using a large number of observers. In particular there were compared results obtained by a flicker photometer and by an equality-of-brightness photometer, with different degrees of color difference. In terms of the Ives-Kingsbury test solutions, for which the proposed normal ratio of transmissions (with a 4-watts-per-candle carbon lamp) is 1.00, the average of 114 observers gives a ratio of 0.99. By using these test solutions results obtained on the flicker photometer by a small number of observers can be corrected so as to give normal values with a high degree of accuracy. In general, equality-of-brightness measurements were found to vary in proportion with the test ratio, but erratic variations often overshadowed these systematic differences. For sources having relatively high intensity in the blue flicker values tended to fall below those obtained on the usual standard photometers, but the differences were comparable in magnitude with the uncertainty of the latter values.

INTER-LABORATORY COMPARISONS OF TUNGSTEN LAMPS INVOLVING COLOR DIFFERENCE

The paper by G. W. Middlekauff and J. F. Skogland on the above topic reported a comparison of inter-laboratory photometric measurements involving considerable differences in color. The results are of value in showing the agreement to be expected between the results of groups of experienced observers working by different methods and with different kinds of photometers. The characteristics of those engaged in photometric work at the Bureau of Standards were discussed, and there was obtained additional evidence of the accuracy of the values assigned to the bureau's 1.5-watt-per-candle tungsten standards, which had previously been verified in an inter-comparison with the National Physical Laboratory of England.

THE INTEGRATING SPHERE OF THE BUREAU OF STANDARDS

The 88-in. integrating sphere of steel and concrete built during the last year at the Bureau of Standards, Washington, D. C., was described by Dr. A. H. Taylor, who presented a paper prepared in collaboration with Dr. E. B. Rosa. The method of introducing the lamp socket into this new sphere is unique. At a point to the left of the door, just above the equator, a section of 0.5-in. conduit passes into the sphere to a distance of 13.5 in., at which point another section about 23 in. long is hinged to it. At the end of this section are two lamp sockets, one above the other, so that lamps can be burned either tip up or tip down. Voltage and current leads are attached to the sockets in parallel, passing through the conduit and around the hinge. A short, stiff, curved rod is attached to the stationary section just behind the hinge, and a spring is attached to this rod and to the movable section. One end of a flexible cord is fastened to the door, and the other end to the conduit near the lamp sockets. When the door is opened the sockets are drawn forward to the opening by the cord to facilitate the change of lamps, and upon closing the door they are drawn by the spring to a point about 10 in. from the center of the sphere. Although only an approximate estimate can be given of the cost of constructing the bureau's new sphere, this cost is placed at about $75 for materials and as much more for labor, exclusive of the time of the laboratory assistants.

THE BOX PHOTOMETER

L. O. Grondahl followed with an account of his experiments with a box photometer measuring 42 in. by 33.75 in. by 24 in. and painted inside with lithopone, a second box, 26 in. by 26 in. by 37 in., having its interior corners filled by triangles of cardboard measuring about 16 in. on a side, and with a 26-in. cubical box having its corners eliminated as before. In drawing conclusions from his experiments, Mr. Grondahl observed that, while no integrating photometer of the box type could be an instrument of high precision, for sources of similar distribution rectangular boxes might well be substituted for the sphere, while the cubical box with corners eliminated as described proved to be a satisfactory substitute for a sphere, even for dissimilar and asymmetric sources.

Engineers Hear Military Lecture Under Army Supervision

Limited in numbers only by the capacity of the main auditorium of the Engineering Societies Building and a second hall, pressed into service for an overflow meeting, engineers of New York City listened on Monday evening to the first of the series of seven lectures on military engineering and national defense organized under General Leonard Wood's direction by the national societies of civil, mechanical, mining and electrical engineers. Capts. Thomas M. Robins and Richard T. Coiner, Corps of Engineers, U. S. A., explained to two enthusiastic

audiences the organization and duties of engineers in war and what engineers in civil life will be called upon to do in the defense of the United States.

Captain Robins emphasized the fact that warfare as it is conducted to-day is making greater demands upon engineering skill than ever before. But engineering work, he said, is only one of the manifold duties of engineer troops. They must be soldiers, first of all, and must know how to fight

Conference of Public Policy Committee of N. E. L. A.

A two-day conference of the public policy committee of the National Electric Light Association was held at the Engineering Societies Building, New York, Feb. 16 and 17. W. W. Freeman, chairman of the committee, presided. The meetings were held to receive from members of the association representing all sections of the country their suggestions as to the definite public policies the committee may formulate for the benefit of all members of the association and which will represent as well the consensus of opinion of the membership as a whole. Plans were discussed for the systematic development of such work as the committee of the association may decide to promote.

Better Boiler-Room Conditions Urged in Discussion by Ohio Operating Engineers

The need for a liberal interchange of experiences and a better understanding and appreciation of the human element in producing economical station operation were the keynotes of the discussion at the first conference of the station-operating men of the Ohio Electric Light Association, held at the Chittenden Hotel, Columbus, Ohio, Feb. 16, and presided over by Henry B. Dates of the Case School of Applied Science, Cleveland.

After an address of welcome by W. A. Wolls, new-business manager of the Columbus Railway, Power & Light Company, William Long of the Toledo Railways & Light Company read a paper in which he pointed out the various problems the station-operating men are facing and, in general, outlined subject matter for the discussion of the thirty men present. A paper on boiler-room operation by N. G. Reinecker, New York Edison Company, dealt with the possibilities of enlisting the interest of the boiler-room men in bringing about better economies. Their place of work, in which they necessarily spend a large part of their time, should be well painted, whitewashed and lighted, he said, for the men's surroundings reflect back on their work. The men should, moreover, be made to feel their importance in the system and should have an opportunity to see and know the results they are accomplishing by various changes in operation. "In other words," said Mr. Reinecker, "educate the men to know how to interpret the various gage and recording-meter readings and install these instruments where they can use them and take an interest in improving conditions. Do not put such indicators off somewhere in the chief's office and then expect the men to profit by the investment in these devices."

The foregoing points were corroborated by E. P. Roberts of Cleveland in a paper which dealt with a number of special considerations in boiler-room design and operation, and more especially the proper coupling together of stoker and boiler. The importance of the human element in the boiler room was emphasized, and J. J. Dolan of Coshocton told of a plan under way to reward these men by some sort of bonus system of pay.

Plans for 1916 Electrical Prosperity Week

At a meeting of the electrical week executive committee held on Feb. 15 at the offices of the Society for Electrical Development in New York it was unanimously decided that the electrical week should be held Dec. 2 to Dec. 9, 1916, inclusive.

"Electrical Prosperity Week" was again selected for the name for the week with the understanding that if the electrical week advisory committee ask the electrical week executive committee to change the name, "National Electrical Week" is the second choice. The suggested design for the electrical week was submitted and referred to the advisory committee for definite decision.

An electrical week advisory committee was appointed as follows: W. H. Atkins, E. A. Edkins, H. K. Mohr, George Williams, F. H. Gale, A. K. Baylor, J. C. McQuiston, A. A. Brown, N. H. Boynton, Frank S. Price, E. W. Rockafellow, P. L. Thomson, J. R. Strong, J. R. Galloway, George Weiderman, T. A. Wynne, F. M. Feiker, A. A. Gray, F. B. Rae, Jr., E. E. Whitehorne, H. W. Alexander, J. T. Kelly, Hill Griffith, A. J. Edgell and J. M. Wakeman, chairman.

Electric Vehicle Association to Affiliate with N. E. L. A.

Accepting the invitation of President Lloyd and the executive committee of the National Electric Light Association that the Electric Vehicle Association of America become affiliated with the N. E. L. A. as the latter's Electric Vehicle Section, the council of the vehicle association at a meeting Feb. 14 unanimously recommended such action and ordered a special meeting of the association for March 10, when the active members of the organization will vote on the subject.

Under this plan Secretary Marshall and his staff of assistants would become members of the office organization of the N. E. L. A. in the Engineering Societies Building. The 1916 convention of the Electrical Vehicle Association, hitherto held each fall, would this year be held as one of the N. E. L. A. section sessions.

Transmission Company Substitutes Copper for Aluminum Wire to Advantage

On account of the present abnormally high price of aluminum, and also because it has deemed it advisable to increase the capacity of certain of its transmission lines, the Northern California Power Company, Consolidated, of San Francisco has taken down some of its aluminum wire and substituted therefor copper wire. The proceeds from the aluminum wire taken down have been sufficient to cover the cost of copper wire of greater capacity together with the labor and other costs involved. The company has made this change from aluminum to copper wire on its high-tension lines between Hamilton City and Nord, a distance of about 9 miles, and between Hamilton City and Chico, a distance of about 13 miles. It is at present engaged in making a similar change from Hamilton City toward Butte City, a distance of about 20 miles, and as soon as this is finished it will change the line from Orland northerly, a distance of about 30 miles. For some time the company had had in contemplation increasing the size of certain of its transmission lines, but had not made the change on account of the large expense involved. Like a number of other large companies, the Northern California Power Company has taken advantage of the present metal market to dispose of its aluminum line.

Reorganization in the Patent Office

Bill Providing for Increases in the Force of Assistant Examiners Signed by President Wilson

The President on Feb. 15 signed Bill S. 900, which passed the Senate on Dec. 16 and the House of Representatives on Feb. 9. The bill provides that there shall be in the Patent Office a commissioner of patents, one first assistant commissioner, one assistant commissioner and five examiners in chief, who shall be appointed by the President by and with the advice and consent of the Senate. The first assistant commissioner and the assistant commissioner shall perform such duties pertaining to the office of commissioner as may be assigned to them respectively from time to time by the commissioner of patents. All other officers, clerks and employees authorized by law for the office shall be appointed by the Secretary of the Interior upon the nomination of the commissioner of patents in accordance with existing law. The salaries of the officers have been fixed as follows: The commissioner of patents, $5,000 a year; the first assistant commissioner of patents, $4,500 a year; the assistant commissioner of patents, $3,500 a year; five examiners in chief, $3,500 a year each. The bill also amends Section 440 of the Revised Statutes so that there shall be one chief clerk who shall be qualified to act as a principal examiner, one librarian who shall be qualified to act as an assistant examiner, five law examiners, one examiner of classification, one examiner of interferences, one examiner of trademarks and designs, one first assistant examiner of trademarks and designs, six assistant examiners of trademarks and designs, forty-three principal examiners, eighty-six first assistant examiners, eighty-six second assistant examiners, eighty-six third assistant examiners, eighty-six fourth assistant examiners, and such other examiners and assistant examiners in the various grades as the Congress of the United States shall from time to time provide for.

A bill intended to accomplish the purpose for which this bill was introduced was introduced into the Sixty-third Congress as H. R. 18,031. That bill passed the House and at a later time passed the Senate. It was passed so late in the session, however, that in some way not exactly understood by the members of the committee on patents the enrolled copy did not reach the President before the final adjournment of the Congress.

Bill S. 900 was introduced into the Senate on Dec. 7 by Senator James, chairman of the Senate committee on patents, and with the exception that the words "in accordance with existing law" were added at the end of Section 1 of the bill, it does not vary from the bill previously passed by both houses.

The bill makes no change of salary over the salaries carried by the appropriation bill for some years past and creates no new office, but changes the number of employees. The greatest and most important change made is to equalize the number of first, second, third and fourth assistant examiners. Before the passage of the bill there were 110 fourth assistants, 88 third, 73 second and 63 first assistant examiners. This was objectionable for the following reasons: Each primary examiner had to supervise the work of twice as many assistants as was the case thirty years ago. It is not practicable to increase the number of primary examiners because it splits up the classes to an inadvisable extent, and the only relief for an excessive number of assistants relatively to the number of primary examiners is to have more assistants of higher grades and therefore better trained in their work and with better knowledge of their classes. There were on an average two and one-half fourth assistants and one and one-half first assistants to each division. The bill equalizes this and permits two assistants for each division and each grade.

It is expected that the new measure will also tend to keep the assistants longer in the office because of the increases of the rate of promotion. During the first two or three years the assistants are of slight value. The present minimum salary is necessary to get the class of men needed, but it is only by keeping them in the Patent Office for about eight or ten years that the average quality of service required can be secured. The increase in the appropriation per annum by reason of the equalization of the number of assistants is less than $23,000, and as the total appropriation for salaries for the whole number of assistants is more than $600,000, this slight increase in salary of the assistants, it is expected, will be far outweighed by the percentage of increase of efficiency. The total number of increases in the force by the bill is thirteen, and the total annual increase of salary due to this increase in the members of the force and organization of the assistant examiners will be slightly more than $55,500.

The bill was strongly urged by Thomas Ewing, commissioner of patents, who pointed out the need of the reorganization and the increase of the force in the Patent Office. He pointed out that the business of the office is larger than it has ever been, that the number of applications filed and the labor of examining each application increase steadily with the growth of the literature of the various arts, so that the office force is less adequate to do the work which it has had to do than it was ten years ago.

Tungsten-Lamp Patent Decision

General Electric Company's Patent Sustained by United States District Court in Suit Involving Infringement

On Tuesday of this week Julius M. Mayer, judge of the United States District Court for the Southern District of New York, handed down a decision in the suit in equity brought by the General Electric Company to restrain infringement by the Laco-Phillips Company of a patent, No. 1,108,502, granted to Messrs. Just and Hannaman for "incandescent bodies for electric lamps." This case, which has been in the courts now for some time, is the result of a litigation to determine whether the Laco-Phillips Company, which imports all of its lamps from Holland, was infringing the fundamental patents of the tungsten lamp, which are held by the General Electric Company.

The patent under consideration was filed in this country in 1905 and was granted some seven years later to Messrs. Just and Hannaman, who asserted that "the present invention has for its object incandescing filaments for incandescent electric lights or lamps composed of substantially pure tungsten." Their claims are as follows:

"1. A filament for incandescent lights constructed of tungsten in a coherent metallic state and homogeneous throughout.

"2. A filament for incandescent lights consisting throughout of substantially pure metallic tungsten of high fusing point and electrically conductive, the light-emitting properties of the filament being due to the coherent homogeneous metallic nature of the tungsten.

"3. A filament for electric incandescent lights comprising dense, coherent tungsten metal having its fusing point at approximately 3200 deg. C. and capable of incandescent efficiency at the rate of less than 1 watt per candle-power, and substantially free from perceptible disintegration at that efficiency."

Two lamps, "A" and "B," being typical of those im-

ported by the Laco-Phillips Company, were offered as testimony. In lamp "A" the filament was made by the "squirting" or sintering process, while lamp "B," which has been imported only since 1912, has a filament of drawn wire. It was shown that the filament in the drawn-wire lamp was made by a process invented and patented by William D. Coolidge of the General Electric Company, the patent being No. 1,082,933.

The Laco-Phillips Company offered two main defenses in the judicial action, first, that the patent in suit was anticipated by the prior patents of De Lodyguine and Welsbach, and, second, that the patent in suit was not infringed by the drawn-wire filament exemplified in the defendant's lamp "B."

It was brought out in testimony that the effective date of the invention in suit was Nov. 4, 1904, and reference was made to a decree in the Circuit Court of Appeals which was handed down in October, 1892, by Judge Lacombe in the case of the Edison Electric Supply Company versus the United States Electric Lighting Company (52 F. R. 300), in which it was settled that the material of which the filament is composed may be the subject of invention.

In further considering the subject of whether the prior art had advanced to such a degree as to prevent any new development in the filament being an invention, the court brought out that there were for a time two motives to find an effective departure from the carbon filament, first, to discover something new which would open up fresh fields for commercial success, and, second, the hope of avoiding the Edison patent with its resultant requirement of tribute. In 1901 John W. Howell, in a paper presented before the Association of Edison Illuminating Companies, and Dr. L. K. Bohm, in the Electrical World of Jan. 13, 1894, the court showed, both pointed out that changes would be made in the filament and that such improvement would be of the nature of invention or discovery.

Abstract of Court Decision

A considerable portion of the court's decision was taken up with the history of the invention of the tungsten lamp, which is briefly as follows:

In 1902 Messrs. Just and Hannaman were assistants to Professor Vortmann of the Technical High School of Vienna, and in August of that year they attempted to develop a boron filament, the experiment ending in a failure in 1904. Meantime they had taken up work with tungsten. The early attempt failed, as is seen in the German patent of 1903 (No. 154,262). They succeeded, however, in producing a pure tungsten filament, and claims for a patent were filed on Nov. 4, 1904, in Great Britain, as patent No. 23,899, and in France on the same date, as patent No. 347,661. The same claims were filed in the United States on July 6, 1905. Prior to the introduction of the tungsten lamps in the United States, the patentees, in 1905, had their invention taken up by a Hungarian factory, and in 1906 sold the German rights to a German corporation, and later their rights in the United States to the General Electric Company for $400,000, half of which went to a rival inventor named Kuzel by virtue of a pooling arrangement between the parties.

The issue of the patent in the United States was delayed for two reasons—first, there were some four claimants to the invention, and, second, one of the claimants was found to have fraudulently introduced into his application matter taken from the Just and Hannaman case. A decision on the discovery of the fraud was rendered on July 7, 1911, after which the other applicants were at liberty to press their claims. Inasmuch, however, as the General Electric Company, which owned by assignment the rights of the other claimants, rather than have a patent litigation before the Patent Office, carefully investigated the claims of each to ascertain which was the real invention, the claims of Just and Hannaman were presented by the General Electric Company for patent rights in preference to those of Kuzel and Von Bolton.

In reply to the defendant's contention that other inventors antedated the claims of the patent in suit, the court dismissed the Kuzel application and held that the Von Bolton application was insufficient in disclosure and inoperative. Welsbach, it was shown, was not working on a tungsten lamp, but on one of osmium. The court pointed out that Von Welsbach did not see tungsten, a cheap metal, right at his door, as it were, but departed, in the words of the court, "into distant chemical lands on a vain journey of exploration, at the end of which the osmium lamp was a wreck abandoned to its fate." The two Lodyguine patents were thought to be of importance because of the elaborate experiments calculated to prove, as a matter of fact, that a pure tungsten filament could be produced. The first patent, No. 575,002, filed Jan. 4, 1893, was issued on Jan. 12, 1897, and its first claim is for "an incandescing illuminant for electric lamps of an incandescing metallic body, and containing a conducting fillet of different material substantially as described." The metals mentioned in this set of claims were molybdenum and tungsten, rhodium and radium, ruthenium and osmium, and chromium. The second patent involved, which was filed on April 10, 1894, was issued on Jan. 19, 1897, being No. 575,668, and refers to the previous patent, stating that molybdenum and tungsten were best fitted to the process of manufacture. But where any patricular metal is mentioned in the claim, that metal is molybdenum, and not tungsten. The claims did not disclose the pure tungsten filament, but a high-resistance metallic coating on a carbon or platinum base. The court pointed out that the inventor had the resources of the Westinghouse company at his disposal, but produced nothing. Concerning the prior-art contention the court concludes: "Experiments made some twenty years later strike the stone wall of practical history and there lie demolished, and by the same token the prior arts failed to negative invention by Just and Hannaman."

The court next considered the question of whether the Laco-Phillips lamp having a drawn-wire filament infringed the patent in suit, which discloses a filament made by the process of "squirting." The defendant made two contentions: first, that the file-wrapper history discloses that Just and Hannaman renounced the drawn-wire process, and, second, that, in view of the prior art, the patent in controversy must be limited to a product produced by the process therein described.

In answer to the first contention the court says: "The file wrapper might seriously embarrass the plaintiff if the invention were for a process, but it was for a product. This is one of those cases where, by the very virtue of the fact that the result was new and meritorious, not too much emphasis is to be placed on the fencing with the Patent Office. The most, therefore, that the file wrapper shows adversely against the plaintiff is that the inventors who pointed out the desired product and showed two ways in which to produce it failed to appreciate that there was still another way in which the same results might be obtained. The fact that later someone found another and better way to manufacture the product does not in this case affect the validity of the patent which originally disclosed the product and at the same time described operative means for obtaining it. The patent is valid, all claims are infringed by lamps 'A' and 'B,' and a decree with cost may pass accordingly."

Design of Million-Volt Experimental Transformer

Construction and Operation of an Unusual Type of High-Tension Unit Displayed at the Panama-Pacific International Exposition

BY GUY L. BAYLEY
Chief Mechanical and Electrical Engineer of Panama-Pacific International Exposition

THE 1000-kva. high-tension transformer installed at the Panama-Pacific International Exposition for use in connection with high-tension experimental work is of interest to engineers on account of the originality shown in its design and construction and its remarkable performance under abuse. As shown in the accompanying illustrations, the transformer is of the core type with all of the coils mounted on the top section of the rectangular-shaped core. The core is 16 in. by 16 in. in section, and the opening has a clear length of 7 ft. with a clear height of 40 in. The weight of the transformer, which is 32,000 lb., is carried by the bottom horizontal member of the core.

CONSTRUCTION AND ARRANGEMENT OF WINDINGS

The most radical departure from standard practice is found in the construction and arrangement of the windings. All coils are circular in shape and machine-wound with flat conductors which are separated by paper insulation. Each low-tension coil consists of forty-four turns of 281-mil by 20-mil copper ribbon with two layers of 6-mil paper between conductors. The high-tension coils, with the exception of the graded-end coils, are each made up of 212 turns of 135-mil by 8-mil aluminum foil with three layers of 6-mil paper between turns. The paper used is slightly wider than the conductor, and great skill has been shown in the construction of the coils.

The low-tension coils, of which there are 122, are spaced ¼ in. apart and form, when assembled, a unit 67 in. long, 23 in. in inside diameter and 28 in. in outside diameter. Each coil is wound for 1150 volts, and two coils in series form a group, of which there are sixty-one connected up in parallel to copper busbars. The claim is made that the use of the series parallel system of connections results in a uniform distribution of voltages among the high-tension coils. One of the busbars is grounded to the frame and earth, thus interposing a ground shield between the primary and secondary windings which effectually prevents any static disturbance from reaching the low-tension windings.

The 190 high-tension coils are connected in series by a top-bottom connection method in order to distribute uniformly the stress between coils. The spacing between coils is 7/32 in., and when the coils are assembled they form a tube 71 in. long, 43 in. in inside diameter and 51 in. in outside diameter. One terminal of the high-tension winding is grounded to the frame and earth, while the other is protected against dielectric rupture of oil and adjacent insulating materials by having placed about it a generously proportioned electrostatic guard ring or shield.

The general assembly of the transformer is shown in Fig. 3. The low-tension windings were slipped over the top yoke of the magnetic circuit and separated from the high-tension coils by means of a paper tube of unusual proportions. This tube is 92 in. in length, 6 in. thick, 42 in. in outside diameter, and weighs approximately 2000 lb. Special interest attaches to this tube as the impregnating and winding were done in a large steel-plate cylinder under a high vacuum. All of the mechanism for winding was installed in this cylinder,

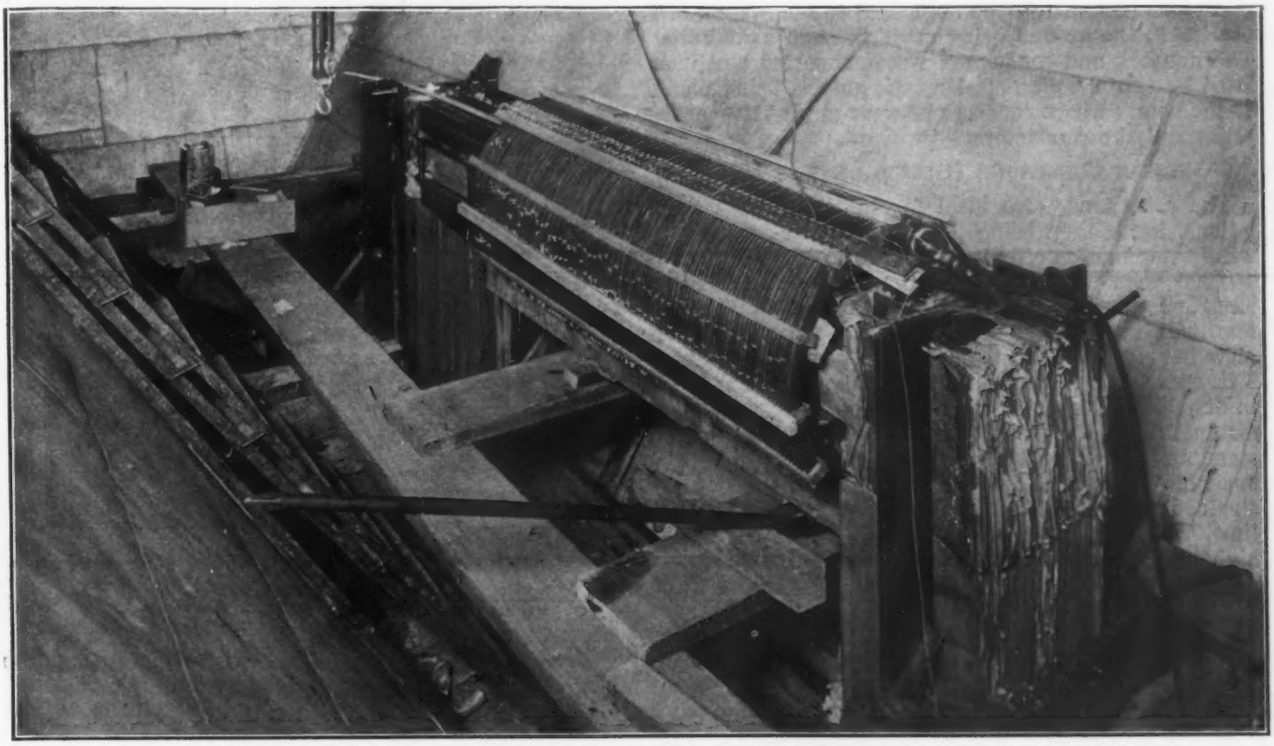


FIG. 1—VIEW DURING ASSEMBLY, SHOWING CONSTRUCTION OF RECTANGULAR-SHAPED CORE AND ARRANGEMENT OF LOW-TENSION COILS

and glass openings were provided for observing the process.

Oil Insulation Arrangements

The transformer was installed in an open-type concrete tank or pit lined with galvanized iron. The depth of oil over the electrostatic shield was 6 in., and 225 barrels of oil were required. The surface of oil in the

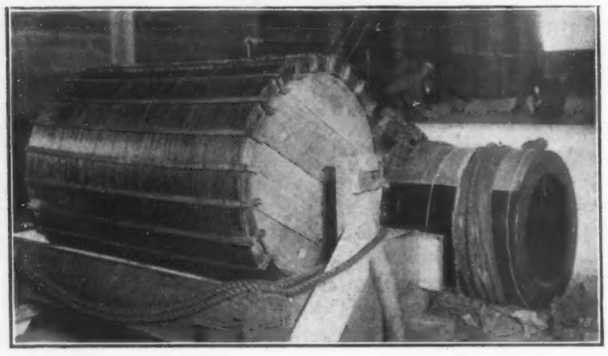


FIG. 2—HIGH-TENSION COILS AND PAPER INSULATING TUBE

tank had an exposure of 288 sq. ft., and some fear was felt that there would be considerable absorption of moisture from the air. Contrary to expectations, the dielectric strength of the oil improved after the transformer had been operated for a short period. Before use the oil tested from 18,000 volts to 20,000 volts with a gap of 0.2 in. between 0.5-in. diameter spheres, but under the electrostatic stress accompanying operation the dielectric strength rapidly rose until on test the oil stood a voltage of 40,000, at which value it remained throughout the period of operation.

The high-tension lead was brought out vertically through the oil to a clear height of 11 ft. and there connected by means of a horizontal lead 100 ft. in length to an aerial screen or network of wires supported 25 ft. above the ground and exposing an area 50 ft. by 50 ft. to the earth. An adjustable horn-gap discharge to earth was installed in the main lead to the screen, connection to the ground being made through a water jet. The network and conductors were supported and insulated by tarred ropes, electrostatic shields being placed at the points where connections were made between the ropes and the conductors.

Severe Conditions Imposed on the Unit

The conditions were ideal for high-frequency oscillations, the system being nothing more or less than a wireless oscillation circuit on a large scale. With about 450,000 volts and the horn-gap discharging, standing electrical waves were established throughout the system, which were made evident to the eye by a corona glow having well-defined nodes and loops spaced about 8 ft. apart. Each loop of visual corona was about 10 in. in diameter, which phenomenon, with due regard to the distances from surrounding objects, indicates that standing waves having potentials of 2,000,000 volts must have existed. This extreme punishment severely strained the insulation, and as a consequence, at a later time, when the same circuit conditions obtained with higher voltages, 120 insulating spacers were broken down. Under normal conditions these spacers would be required to stand only 5000 volts, but on subsequent test they stood 40,000 volts each, thus indicating that the stress between coils at break-down was eight times the normal. In spite of the loss of these spacers, others were quickly substituted, and in little more than a day's time the transformer was operating again. The ease and speed with which the repairs were made illustrate the great advantage of an open type of construction, as without doubt any transformer having taped coils could not have undergone similar punishment and been repaired in such a short time.

Another advantage in this type of construction was that the conductors were all exposed to the oil and the heat generated in the windings was rapidly transferred to the oil. The arrangement of the coils was such that a rapid circulation of the oil is possible, and under test it was found that the difference in temperature between the windings and the oil at full load was about 3 deg. Fahr., which difference did not appear to increase materially at overloads, owing doubtless to the increased circulation of the oil at the higher temperatures. The transfer of heat to the oil and the circulation of oil around the coils was so perfect that the danger of overheating was eliminated with satisfactory means for cooling the oil.

With a supply voltage of 500,000 to the wire screen the electrostatic field beneath and adjacent thereto was so strong that a vacuum tube held within the field would glow and sparks could be drawn from metal bodies which were insulated from the ground. The discharge from hairpins, brooches and metallic trimmings worn by women visitors caused their owners considerable discomfort. When an arcing ground was established at the horn-gap the electrostatic field was so intense, owing to surges, as to cause an involuntary bending of knees on the part of those standing in the vicinity of the screen. At night the corona effects were

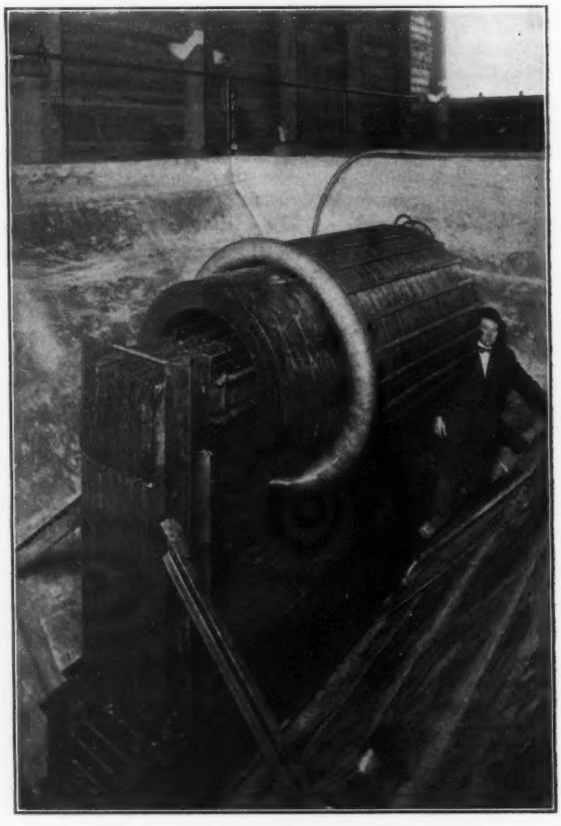


FIG. 3—COMPLETED TRANSFORMER IN ITS OPEN-TYPE CONCRETE OIL TANK

most impressive, particularly in the transformer house, where the conductors and basket screen were aglow. The ozone from the discharge was quite noticeable.

In attempting to bring this transformer up to its rated voltage of 1,000,000 it was found that at 600,000 volts the oscillations or surges probably resulting from the corona discharge and heavy leading current caused

short-circuiting between coils and from coils to the grounded lining of the tank. At such times the arcing around the high-tension coils gave the transformer the appearance of an electric furnace working under oil, and the ability of the coils to withstand such treatment without break-down was one of the most impressive features of the trials. For charging the aerial lines and screens, which were composed of several hundred feet of wire, about 400 kva. was needed when the voltage was around 500,000.

This installation was made at the personal expense of C. H. Thordarson of Chicago, Ill., the Exposition merely furnishing a suitable building and the necessary power and attendance. The oil required was loaned by the Union Oil Company of California. Valuable assistance was rendered by Prof. Harmon F. Fischer in making tests and overcoming many of the difficulties encountered. Unfortunately, the installation was completed at so late a date that it was impossible to carry out the experimental work planned. The transformer, however, is to be erected in Mr. Thordarson's laboratory in Chicago, and no doubt technical data of value will result from his experiments.

Without doubt the Thordarson transformer marks a step forward in transformer design, particularly from a mechanical point of view. Nothing could be more convincing as to the merits of the design than the way the transformer stood up under the abuse to which it was repeatedly subjected and the ease and speed with which repairs were made to defective coils.

Opportunities for Young Electrical Engineers

I—In the Central-Station Field

BY JOHN F. GILCHRIST

Vice-President Commonwealth Edison Company, Chairman Educational Committee, National Electric Light Association

Mr. Gilchrist calls attention to the fact that the commercial as well as the engineering and operating departments offer fields of work for electrical engineers in central-station companies. His article is followed by letters of comment on the first installment of the series of articles, which appeared in the issue of the ELECTRICAL WORLD *of Jan.* 15. *In early issues will appear articles on the young engineer's opportunities in research, in manufacturing, in telephone engineering, in the electric-railway field, and in the allied arts and industries.*

IN the central-station industry the engineering and operating departments have been the goal for the engineering graduate, with the result that the commercial side of the industry has up to recent years not appealed to him. The condition which exists at the present time is that too many of the graduates want to get into the engineering and operating end of the business, with the result that those departments are filled with college men. On the other hand, a large number of men are to be found in the commercial end of the business who have had no special education or training. In many instances they are getting ahead faster than the college-bred man is in the engineering end of the business. I have often wondered what some of these men who have made good in the commercial end of the business without a college education could have done if they had had a technical education. We need as good engineers in the commercial end of the business as in its other branches.

A report of a committee of the National Electric Light Association a few years ago brought out the fact that in manufacturing companies the commercial departments consisted of 75 per cent technical men, while in the commercial departments of the central-station companies the percentage was 5 per cent to 15 per cent. During the past few years this percentage has largely increased, and at the present time approximately 25 per cent of engineering graduates are looking for opportunities to enter the commercial departments of central-station companies.

A large number of men now occupying responsible positions started in the business twenty or more years ago and accumulated their knowledge through individual study and the school of practical experience. The great progress in the business during the past twenty years is such that at the present time a thorough foundation in the theory is necessary for men entering the commercial departments if they expect to attain any large degree of success. The successful commercial engineer of to-day should have good business ability backed up by a thorough knowledge of electrical, mechanical and in many cases chemical engineering. The real demand to-day is not so much for the ordinary salesmen as for men who are endowed with or who have developed characteristics which will enable them to advance to the higher positions in the companies. The tendency toward centralization of generating stations distributing energy over large territories forecasts cheaper and better service to users, thereby opening a large field of activity at present undeveloped, which will require a large number of trained men to assist in its development. The demand to-day is for commercial engineers capable of applying electricity economically to all classes of business.

As has been pointed out before, the college man has an opportunity during his college career to analyze himself and to ascertain as far as possible the line of work for which he is best adapted. He should receive assistance from his university along those lines. Many men are attracted to a certain business through desire alone and do not possess the necessary characteristics for success in that business. One of the criticisms of the man fresh from college is that he cannot immediately appreciate that he has entered a business and to attain any degree of success must start at the bottom and patiently work his way to the higher positions. Many college men look upon the business as an educational institution and after learning certain duties are impatient to advance to other duties. Oftentimes they make so many changes in positions that at the end of a few years they find they have got nowhere at all.

This ambition in a way is laudable, but in a large number of cases it has acted as a handicap to success. The college man should first obtain a thorough foundation by a systematic training for the business, and the greatest success can be made only by reasonably slow

progress at the start. His success should be measured over a period of ten or fifteen years rather than upon the immediate apparent success after graduation.

At the universities men are graded almost entirely upon scholarship. When the employer comes along the professor looks up a man's scholarship record, while the employer particularly sizes up the man's personality, ability to mix, health and character, as well as ambition—all of which are, perhaps, quite as important as scholarship. It is to be hoped that our universities may add to existing standards those of the employer in estimating a man's ability. A prominent Middle West university has for some years given serious and systematic attention to the development of qualifications other than scholarship which are necessary for success in the various lines of the electrical industry. This system assists in placing the graduates in the work which should obtain for them the greatest degree of success. This university has adopted a system of grading, considering the following qualities:

Mental caliber,	Accuracy,
Popularity,	Address,
Speed,	Industry,
Self-reliance,	Reliability.

A record of each student is made twice during the senior year in accordance with the above characteristics. The first record is made in the first semester by the instructors as soon as they feel sufficiently acquainted with the seniors to make a reliable estimate of their personal qualities. In addition to the judgment of the instructors, a committee selected by the students themselves and made up of the most experienced and thoughtful men of the class grade the class independently of the instructors. It is interesting to note that the students' estimates are almost invariably below those of the instructors. These records are sometimes used in comparing notes with the impressions obtained by prospective employers. They are also a basis for recommendation upon graduation. The students are encouraged to discuss their failings and are assisted in improving any characteristics in which they appear to be weak.

Most universities appreciate the necessity of a short, special-training course conducted by central-station companies for college graduates before putting them permanently into the business. The Commonwealth Edison Company, in conjunction with the Public Service Company of Northern Illinois, the Federal Sign System (Electric) and the Middle West Utilities Company, appreciating the necessity of a preliminary training for men entering the central-station business, has for a number of years conducted a thoroughly organized educational department for the purpose of selecting and training men of engineering education having the desired characteristics. The men selected are given an eleven months' course in central-station practice, about equally divided between practical experience in ten or eleven different departments of the companies and classroom instruction, including lectures and problems.

This course has been found valuable to the companies and of particular advantage to men possessing the desired characteristics in addition to their technical foundation. The following characteristics are considered in the selection of men for this course:

Honesty,	Physique,
Health,	Habits,
Attitude,	Accuracy,
Personality,	Aggressiveness,
Mental activity,	Enthusiasm,
Tact,	Industry.

The men are selected for this course with a view to their capacity to rise to the higher positions in the companies later on.

The committee on relations with educational institutions of the National Electric Light Association, having in mind the idea of giving the undergraduates instructive employment during their vacation periods and familiarizing them with the general organization of the central-station companies, obtained vacation employment from various member companies for 260 undergraduates selected from applications received from university students in the vicinity of the different companies. It is anticipated that some similar arrangement will be made by this committee to obtain employment for undergraduates during the coming summer vacation.

Discussion by Readers

Below are a few of the letters received commenting on the first article of the series, printed Jan. 15. The editors will appreciate the opportunity of publishing all letters which will help the young electrical engineer get his sense of direction in a great industry.

To the Editor of the ELECTRICAL WORLD:

SIR: Three ideas well worthy of further analysis and emphasis stand out in bold relief from a recent article entitled "The Young Electrical Engineer's Opportunities." They may be stated briefly as follows:

1. One should analyze his own personal tendencies and characteristics in order to become most efficient and successful.

2. Two distinct types of men exist in the technical field, i.e., the "business" type and the "laboratory" or research type.

3. The field for the prospective electrical engineer is broad, if he, as a result of environment and training, is not too narrow to realize the fact.

As one interested in technical education, the writer is anxious to analyze these statements further and to learn how best to meet the demands of the present decade for technically trained electrical engineers.

The majority of technical students, and even of graduates of some experience, do not realize the extent to which personal characteristics count, as contrasted with pure technical training. They neither appreciate the necessity of developing such characteristics and broadening their training nor do they make sure that the position they are endeavoring to fill, or even that which they consider as their goal, is one for which they are primarily and peculiarly well fitted by personal characteristics. The librarian of a large university stated recently that the engineering students make little use of the library as compared with those of other departments. Is this the cause or the effect of the much discussed narrowness of the average engineer? It is at least significant and worthy of careful investigation.

To what extent will the engineering graduate of the future have to combine the necessary qualities of the "business" and "laboratory" types? The executive must do this to a very large degree, and more technically trained men are annually entering executive positions. Should technical training tend to merge these two types, or should the two be carefully classified and different treatment given to them as far as possible?

If the latter procedure is desirable, the large university dealing with many individuals of widely varying characteristics, tendencies and abilities is handicapped unless it is prepared to break up its large classes into relatively small groups which shall receive different training. In short, to continue the analogy of the article, it would be a waste of time and money, not to mention technical training, to endeavor so to standardize ammunition that it might be adapted to several gages or types of guns. A forty-four-caliber man provided with twenty-two-caliber shells will simply find them rattling around within and will be forced to give up with "no game." Provided with the proper ammunition, however, and "rifled" with the correct depth, breadth

and pitch, he will be found not only to "carry" but to penetrate.

Nor should the twenty-two-caliber man be loaded with even an average course of much larger caliber which never gives him opportunity to glance about him and acquire the many intangible amenities which should form a very large part of a technical training and thereby assist him in filling his proper niche in the world. Such men are needed and must be correspondingly well trained for the place they are destined to fill.

It is the opinion of the writer that the "business" type will always be more or less a misfit in a "laboratory" position, and the research man will, generally speaking, be neither successful nor happy where the dollar is always hiding from him the unfathomed mysteries of the hysteresis loop or the test tube. Both may be blended into the executive with success.

If the three sections of senior students in electrical engineering which the writer meets three times a week in so-called "alternating-current theory," instead of being arbitrarily selected because their numbers preclude their meeting together, could be wisely classified by some practical psychologist—or, better, by three specialists—into groups of business, executive and laboratory engineers—shall we say?—and, further, if the training of each could be fashioned best to develop those latent qualities which may be at present either dormant or actually thwarted, the experiment would certainly be enlightening, and possibly the results might prove startling in their efficacy.

The good old law of "supply and demand" is as applicable to the output of the technical university as it is to the factory or to the farmer seeking a market for his crops. It is to be hoped that the present "demand" for technical training, which is admittedly greatly different from that of a decade ago, may be met by university faculties and administrators, in co-operation with the executives of the electrical profession, with a most efficient molding of the best available "raw material" into a finely finished product of proper caliber, that it may "carry" to the new problems of the next decade, and that it may penetrate and effectively explode or execute them.

C. FRANCIS HARDING,
Professor of Electrical Engineering, Purdue University.

To the Editor of the ELECTRICAL WORLD:

SIR: I have read with great interest the first of your series of articles on "Opportunities for Young Electrical Engineers," and I believe that this series of articles will prove a great boon for the young men who are taking courses in electrical engineering. I myself have often felt the need of just such a series of articles as I think you are planning in presenting the various fields of electrical engineering to students who are about to graduate. The average engineering graduate has no very definite conception of the character of work in the various branches of the profession, nor does he have much idea of the opportunities in the various fields.

I wish therefore to commend you for publishing a series of articles outlining the opportunities in the different branches. F. C. BOLTON.
Professor Electrical Engineering, Agricultural and Mechanical College of Texas.

To the Editor of the ELECTRICAL WORLD:

SIR: It seems to me that the articles appearing in the ELECTRICAL WORLD on "Opportunities for Young Electrical Engineers" will accomplish something that I have tried to do in a very unsatisfactory way for my graduating students every year, namely, to give them correct ideas about the broad general situation in different branches of the electrical industry and in the industry as a whole compared with other activities. I think that you are performing a service which will be very much appreciated by teachers of electrical engineering in initiating these articles. J. R. BENTON,
Dean College of Engineering, University of Florida.

To the Editor of the ELECTRICAL WORLD:

SIR: I have read with much interest the editorial on "The Young Electrical Engineer's Opportunities" and beg leave to comment as follows:

In the first place, I think this series of articles would carry far more weight if the author's name were given. If he is a big man, the youngsters will respect what he has to say because they will have heard of him. If he is not a big man, he should not be writing articles of this kind.

I think the classification of engineers under the two broad headings "business type" and "laboratory type" is a poor one, particularly in terms of the specifications which the writer gives for the two types. A man who possesses only the qualifications listed by the writer under "laboratory type" might possibly get a job as a routine tester or as a laboratory assistant. The real laboratory men—that is, those who are carrying out constructive research upon which advance in the art is relying more and more—are as far removed from the writer's "laboratory type" as Dr. Whitney of the General Electric Company, for example, is removed from a meter tester.

I think a much better definition would be "business type" and "research type," and the qualifications for these two types should be outlined in an entirely different manner from that given by the writer. In my opinion, the six qualifications—namely, "looking for new ideas, great initiative, personally resourceful, discounts the past, guesses intuitively, creates," are probably more distinctive of the research type than of the business type.

In short, my guess is that the author of this series of articles is an engineer who has been successful along commercial lines and who has known the purely technical man only in various subordinate positions. I should like to have him classify such men as Whitney, Lamme, Steinmetz, Skinner, Pupin, Coolidge, Percy Thomas, and numerous others. To say of any one of these men that he is inclined to be "intolerant, works better under a plan, relies on past performance, discounts the future, measures, plans," would almost be proper ground for a suit for libel. Nor do I think one could justly classify any one of these men as of the business type. HAROLD PENDER,
Professor in Charge Electrical Engineering, University of Pennsylvania.

[In writing the introductory article to this series the editor, in his classification of the qualities of mind that make successful men in the industry, did not intend to imply that individual men could be grouped under one type or the other of those which he designated as the business type and the laboratory type. The men who are successful combine the elements of what he called the laboratory-type qualities of mind and the business-type qualities of mind. He was not attempting to classify engineers under the laboratory type or business men under the business type. He merely used these terms to distinguish qualities of mind found in both business men and engineers. In his opinion, the active engineers of to-day, as well as those of to-morrow, are those who combine the qualities which he listed under the headings "business type" and "laboratory type." He would be Jove-like, indeed, to attempt to analyze, classify and pigeonhole any individual man. Each individual must classify himself.—EDITOR'S NOTE.]

While this series of articles is planned particularly to give young men about to enter the industry a survey of the opportunities it offers as a whole, the thought has been expressed that the men who are hiring young engineers for particular positions may find food for thought in the articles. It is hoped that the series will be discussed by these men in business as well as by the men in charge of engineering courses. The next article in the group will be printed in the issue of the ELECTRICAL WORLD *for March 18 and will present the opportunities for young engineers in the telephone and telegraph companies as seen by M. C. Rorty of the American Telephone & Telegraph Company.*

Construction of a Lecture-Room Oscillograph

Modifications of Instrument to Permit the Projecting of Images of Alternating-Current and Voltage Waves Without Distortion on a Lecture-Room Stereopticon Screen

By H. G. Crane and C. L. Dawes

THE oscillograph has proved itself indispensable as a device for investigating alternating-current waves, switching, and other transient and recurring phenomena. In fact, the recent phenomenal advancements in the size and design of electrical apparatus are in a large measure due to information obtained by means of the oscillograph. Furthermore, the oscillograph is very useful in educational work, especially for making experimental demonstrations of the effects of resistance, inductance, capacity and harmonics upon the current and voltage relations in alternating-current circuits. The mental picture obtained in this way makes a much deeper impression upon the student's mind than the customary method of sketching the waves upon the blackboard.

However, it has been found in connection with work at Harvard University that the ordinary oscillograph is not adapted for demonstration purposes in the lecture room even before small bodies of students, owing to the comparatively small amplitude of the wave images. Because of this limitation of the ordinary oscillograph as a lecture-room device, the writers have developed an instrument that is capable of projecting upon the ordinary stereopticon screen images of alternating-current and voltage waves without appreciable distortion. Further, these wave projections are of such magnitude that they may be readily seen at distances of 200 ft. and more from the screen.

Owing to the high degree of flexibility required by a lecture-room instrument, because of varying projection distances and the many relative positions that the apparatus, the audience and the screen may bear to one another, it seemed advisable to make and mount each element of the instrument as a separate unit capable of being placed in the most advantageous position for any given set of conditions. Consequently, in the instrument under discussion, the arc lamp with its optical

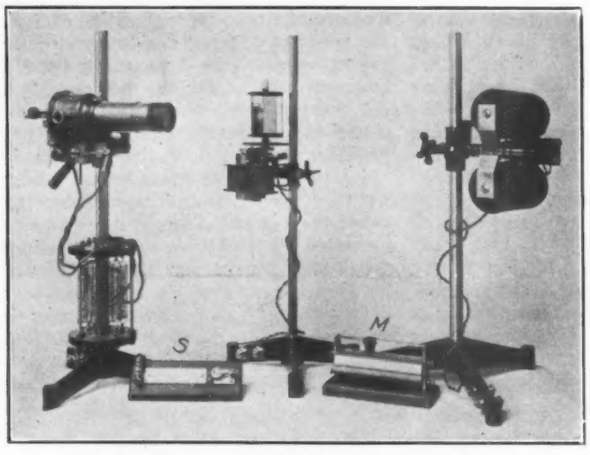


FIG. 1—APPARATUS IN POSITION

system, the magnet and the vibrators, the rotating mirror and its driving motor, are each mounted upon a separate stand and can be readily adjusted to the desired height or position above the base. The shunt and the multiplier are also separate units. Fig. 1 shows a photograph of the entire apparatus assembled. The arrangement has one other great advantage from the teaching point of view. The student sees each element essential to the operation of an oscillograph in its simplest form, and, further, he sees at a glance the relation that each part bears to the operation of the oscillograph.

The units of the instrument are mounted upon their respective standards by means of sliding clamps. Suit-

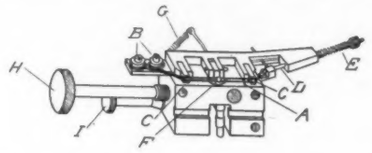


FIG. 2—A VIBRATOR AND ITS MOUNTING

able hand screws hold the clamps in position upon the upright rod of each standard. This construction allows each element to be raised, lowered and adjusted to any desired position. The total height of each standard is 24 in. (61 cm.).

In order that the wave images projected upon the screen may be bright enough to be seen clearly some distance away, a very intense source of light is required. To obtain such a light it has been found necessary to design a special arc lamp. This arc lamp is inclosed in a cylindrical iron casing, and the arc is formed between two pencil carbons arranged at right angles to each other. The carbons are fed by hand through grooved rollers, one being fed from the rear and the other from beneath the cylindrical casing. The arc will burn fifteen minutes without attention. The horizontal carbon is positive, and from its crater comes the light that is utilized in the instrument. An adjustable diaphragm containing a small circular orifice is set in front of the crater of the positive carbon. The size of this orifice determines the cross-section of the beam of light that is thrown upon the screen. Because of the existence of a hot positive crater just behind this orifice it has the appearance of a small incandescent circle. The light from this circle passes through an achromatic lens mounted in the front of the cylindrical casing. This lens gathers the light coming from this incandescent circle and compresses it into a small bundle of parallel beams of high intensity, which is admirably suitable for projection purposes. This feature of the arc lamp, together with its portability, makes it very useful in connection with other experimental or optical work requiring concentrated and parallel beams of light.

Vibrator Element of the Oscillograph

The vibrators are the most essential and delicate element of the oscillograph. In designing them it is necessary to maintain natural frequency and degree of damping high enough to insure reasonable accuracy in reproducing circuit conditions. After much experimenting, it was found that the higher optical efficiency and the greater simplicity of air-damped vibrators more than compensated for the slight errors introduced by insufficient damping. Fig. 2 shows the details of a vibrator element.

A phosphor-bronze filament *A* extends from the base of one of the binding posts *B* over the ivory bridge *C* to the small ivory pulley on the rod *D*, and back again over

the bridge to the other binding post. The ends of the filament are clamped to the binding posts by small machine screws and washers. This method of holding the filament has been found superior to the usual method of soldering because of the facility with which the filament may be replaced without the use of any tools other than a screwdriver. The rod *D* passes through a hole and

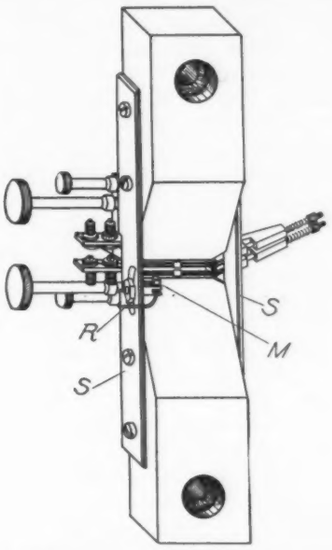


FIG. 3—VIBRATORS AND POLE PIECES ASSEMBLED

is then encircled by the spring *E*, which keeps the filament at a constant tension. This tension may be adjusted by means of a small knurled nut. A small plane mirror *F* about 1/16 in. (1.5 mm.) square is cemented across the two sides of the filament at the center point of the bridge. To obtain an amplitude of vibration of 12 in. each side of the zero line at a distance of 10 ft. from the screen, these vibrators each require about 200 milliamp.

The vibrator is suitably attached to a swivel pin, which is so mounted that the vibrator can be turned in two directions at right angles to each other. A spring *G*, pulling in a 45-deg. direction, holds the vibrator against both its vertical and its horizontal stops. By means of the knurled head *H* the vibrator may be rotated around a horizontal axis, and by means of the knurled head *I* it may be rotated about a vertical axis. These adjustments allow the spot to be brought to any desired position upon the screen.

By actual test we have found that the natural frequency of this type of vibrator ranges from 1500 to 2000 cycles per second, depending upon the degree of compression of the spring *E* (Fig. 2). Therefore the vibrator will respond with a fair degree of accuracy to harmonics as high as the nineteenth in a circuit having a fundamental frequency of sixty cycles per second, and also to telephone frequencies which average 800 cycles per second. The higher natural frequencies are obtained by increasing the filament tension and are therefore at the expense of the sensitivity or amplitude of vibration. The errors due to the temperature coefficient of expansion of the filament are made small by making the filament fairly heavy and thereby reducing the I^2R loss.

SPECIAL VIBRATOR FOR TELEPHONE WORK

A special vibrator has been developed for telephone work. It is necessary that such a vibrator have a specially high natural frequency in order that it may follow accurately the currents of telephonic frequencies. Therefore a lighter filament, a smaller mirror and a closer spacing of the filament on the bridge are used, thus reducing the moment of inertia of the moving system. As only one vibrator is ordinarily required for a telephone circuit, the air-gap of the magnet may be materially reduced and thus increase to a certain extent the flux density in the gap. This further increases the sensitivity.

This type of vibrator requires about 100 milliamp. to produce an amplitude of 1 ft. on a screen 8 ft. from the vibrator. In a recent demonstration before the Boston Section of the American Institute of Electrical Engineers such a vibrator was used in this oscillograph to project upon a screen telephonic current waves produced by speaking in and producing other sound waves in the vicinity of a local telephone transmitter. This same vibrator was also used to throw upon the screen the current waves resulting from conversation between Boston and San Francisco over the transcontinental line. When President Carty of the A. I. E. E. and Dr. Pupin addressed the section on that evening through the medium of 500 individual telephone receivers, their voice waves were thrown simultaneously upon the screen by this oscillograph.

POLE PIECES AND ROTATING MIRROR

In Fig. 3 the vibrator units are shown attached to the iron pole pieces of the magnet. These two-pole pieces are held together by means of two brass straps *SS*. A small auxiliary mirror *M* is mounted upon a small movable brass block. This block is free to turn in a horizontal or in a vertical direction as desired, and is adjusted by means of a small curved rod *R;* it is held stationary in the desired position by friction. This mirror projects a zero line constantly upon the screen, eliminating the use of an extra vibrator for this purpose. The magnet is excited from 110 volts direct current and takes about 0.3 amp. It weighs about 25 lb. The pole pieces (Fig. 3) are held to the core of the

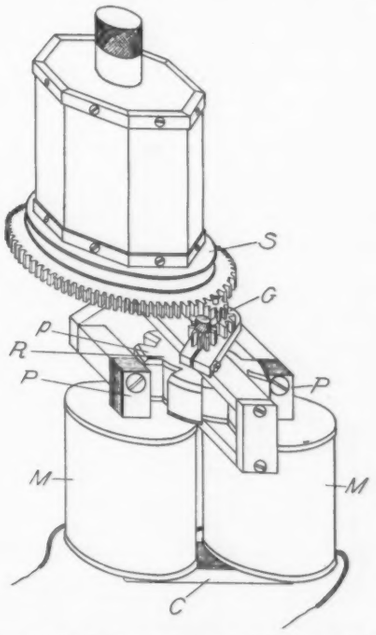


FIG. 4—SYNCHRONOUS MOTOR AND ROTATING MOTOR

magnets by two bolts, one in each piece, making it easy to remove them. The connecting wires are brought to substantial binding posts on the base of the standard as shown in Fig. 1 and Fig. 6.

The rotating mirror (Fig. 4) is composed of eight plane mirrors arranged to form an octagonal prism. It was found that a prism having less than eight sides

could not be used without producing a very marked distortion of the wave along the time axis. This mirror requires the most careful workmanship in its construction. If it is not almost perfect mechanically, the wave upon the screen will be very unsteady in position, and the image shown will be subject to a very pronounced lateral flickering. The mirror revolves about a

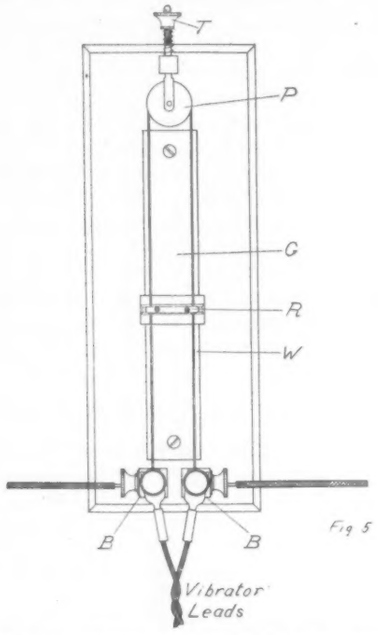


FIG. 5—SHUNT FOR CURRENT VIBRATOR

vertical axis, being driven by a small synchronous motor through a system of gears (*G*, Fig. 4) at a speed of 75 r.p.m., at sixty cycles per second. In the assembled instrument the rotating mirror is protected from dust and injury by a stationary cylindrical shield having a vertical slot just large enough to permit the vibrating beam of light to pass in and out again. A grooved pulley *S* (Fig. 4) allows the mirror to be driven by a belt from a source of power other than the synchronous motor. This method of drive is necessary in telephone work and in many other instances where sufficient or suitable power cannot be obtained from the same source as that from which the vibrators derive their current.

CONSTRUCTION OF MOTOR DRIVING MIRROR

The construction of the synchronous motor shown in Fig. 4 has been made very simple, but at the same time the motor is very effective. Two coils *MM* are wound upon a U-shaped core *C*. These coils are designed to operate upon a 110-volt circuit at frequencies varying from twenty-five to sixty cycles per second. An iron rotor *R* having six projecting poles *p* rotates between the poles *PP* of this alternating-current magnet. The motor operates upon the well-known principle that the magnetic circuit tends so to conform itself that its permeance is a maximum. When the flux between the poles *PP* is at its maximum value, it pulls the rotor *R* around, so that a projecting pole on the rotor lies directly in front of each of the poles *PP*. However, when the flux is passing through its zero value and therefore exerting no pull upon the rotor, an interpolar space is presented to the poles of the magnet owing to the inertia of the rotating system. This type of motor is very sensitive to the shape and depth of these poles; if they are not correct geometrically, the motor will hunt or fail to develop sufficient power. This particular rotor has six poles, giving it a synchronous speed of 1200 r.p.m. at sixty cycles per second. It is started readily by turning the large gear on the mirror by hand until the motor pulls into step.

The multiplier shown at *M* (Fig. 1) consists of high-resistance, zero-temperature coefficient wire wound doubly in one layer upon a glazed aluminum tube. The resistance can be varied by moving a slider along the scraped portion of the wire on the top of the tube. The slider short-circuits adjacent turns, thus making it possible to vary the resistance between terminals any desired amount. The multiplier has a range of from 250 volts to practically zero volts. This method of varying the resistance allows very rapid and close adjustments to be made.

The shunt is shown at *S* (Fig. 1) and also in Fig. 5. Two binding posts *BB* are mounted upon a polished wooden base. A resistance wire *W* is connected between the binding posts, passing over a pulley *P*. By means of the thumb screw *T* the wire can be drawn to the desired tension. A bridge *R* designed to slide along the brass guide *G* short-circuits the two sides of the wire *W*, thus changing the resistance between the binding posts *BB*. The circuit wires and the current vibrator leads are both connected to the binding posts *BB*, but to different thumb screws. By changing the position of the bridge *R* the amplitude of vibration may be increased or decreased as desired.

The shunt is ordinarily designed to carry a maximum current of 10 amp., but it will produce a full-scale deflection with a current as small as 2 amp. Intermediate adjustments are, of course, easily obtained. The distinct advantage of a shunt of this type is that if the bridge *R* should make poor contact or even become separated entirely from the wire *W*, the shunt does not become open-circuited, thus causing the entire current to pass through the vibrator, burning it out.

Fig. 6 shows the approximate positions of the oscillograph units when arranged for projection upon the screen. The light projected from the arc lamp 1 in small parallel beams strikes the two vibrator mirrors and the auxiliary or zero-line mirror at 2. It is then reflected to rotating mirror 3, which draws the vibrating beam into a wave and reflects it on the screen. Good

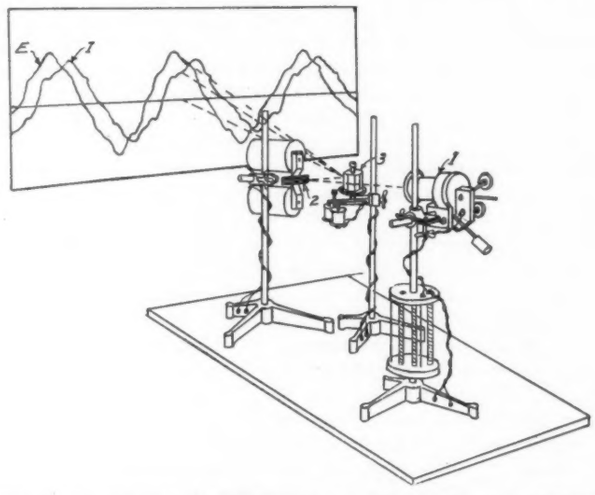


FIG. 6—MOUNTING AND METHOD OF OPERATION OF LECTURE-ROOM OSCILLOGRAPH

results may be obtained if the screen is not more than 12 ft. from the rotating mirror. Under these conditions the amplitude of vibration is about 12 in. each side of the zero line. If a sharper and clearer image is desired, the screen may be moved nearer the mirror, but the amplitude of vibration is proportionately reduced.

Economizing in Duct Space by Use of Sector Cable

Data Comparing Diameters and Conductor Cross-Sections of Sector and Round-Conductor Cable, and Practices of Large Electric-Service Companies Using Former

EVERY electric-service company that transmits energy underground is eventually compelled to increase its total underground feeder cross-section to care for growths in load. When confronted with these changes, the problem of how to provide space for the additional cables presents itself. The solution involves either the laying of more ducts or the employing of cables having relatively more conductor cross-sectional area per unit of outside diameter. The latter method is being employed by several large companies because they have reached the point where they are unable to secure space for larger duct nests, are restricted from laying more ducts because of municipal regulations regarding the tearing up of streets, or wish to utilize their existing ducts to better advantage. Similar cable may also be advisable for other companies which are not restricted in the laying of ducts, as this undertaking is expensive at best.

Each of the large companies referred to as having adopted cable which permits the more economical utilization of duct space is employing sector or "cloverleaf" cable. Paper insulation is being used almost exclusively, principally because it insures maintaining the proper spacing between conductors, which is difficult with rubber insulation owing to its compressibility. In some cases, however, where the cable sheath is exposed to mechanical injury additional protection against moisture is provided by a rubber belt just inside the sheath around the paper insulation.

The following information and tables have been compiled to show current practice in the use of sector cable. Regarding cables now in use, ranging from three-conductor, 200,000-circ. mil, to three-conductor, 350,000-circ. mil, it may be stated that for equal copper temperatures and conductor cross-sections a sector cable will carry greater loads than the round-conductor type because the former affords better radiation from conductors to the lead sheath. This may be readily understood by observing that almost half the periphery of each sector conductor is only a short distance from the sheath, whereas in an equivalent round-conductor cable only a small element of each conductor is as near the sheath, all other radiation paths being much longer.

Based on equal rises in copper temperature and equal diameters, the currents which sector cable and round-conductor type can carry are approximately in the ratio of the corresponding cross-sections. For instance, a 2.5-in. round-conductor cable having a conductor cross-section of 250,000 circ. mils has about five-ninths the current-carrying capacity of a 2.5-in. sector cable which has a cross-section of 450,000 circ. mils.

As to cost, sector cable is slightly less expensive than round-conductor in sizes from No. 000 B. & S. gage up, owing to the small quantities of materials required. The difference in price becomes more marked with the larger sizes, but is not in direct proportion to the difference in amounts of materials used, as the fabrication of sector cable is much more difficult than that of the round-conductor type. However, for the same carrying capacity sector cable is considerably cheaper. When armored cable must be employed, the sector-conductor type has the additional advantages of requiring less armoring material and possessing a much larger percentage of conductor cross-section than armored round-conductor cable.

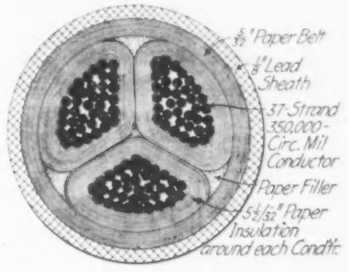


FIG. 2—CROSS-SECTION OF 8000-VOLT SECTOR CABLE USED BY THE NEW YORK EDISON COMPANY

Other comparisons are shown by the accompanying curves. Fig. 1 indicates the relative outside diameters of round-conductor and sector cables having the same copper areas and thickness of insulation. Fig. 3 shows the increased copper area which can be made available in a given diameter and with a definite insulation thickness by substituting sector cable for the round-conductor type. Fig. 4 indicates the amount by which the insulation thickness may be increased without altering the conductor cross-section or increasing the outside diameter by using sector instead of round-conductor cable. The comparisons are based on round-conductor

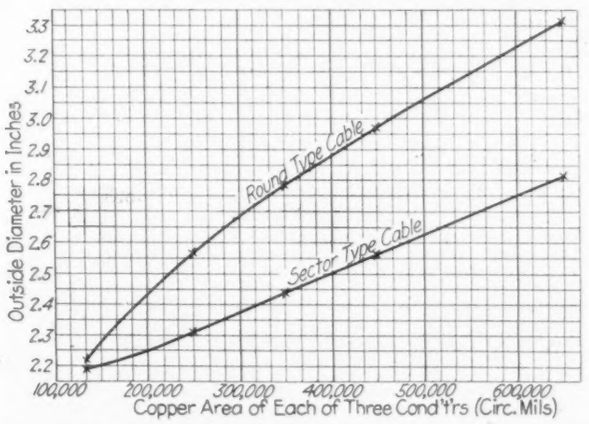


FIG. 1—OUTSIDE DIAMETERS OF ROUND AND SECTOR-CONDUCTOR CABLES HAVING SAME CONDUCTOR AREAS AND THICKNESSES OF INSULATION

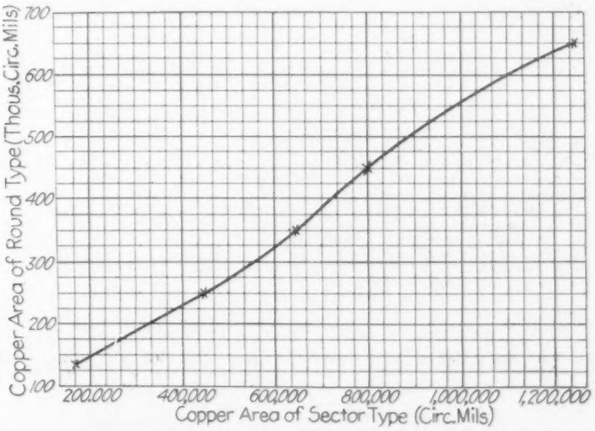


FIG. 3—RELATIVE CONDUCTOR AREAS OF SECTOR AND ROUND-CONDUCTOR CABLES HAVING EQUAL DIAMETERS AND THICKNESSES OF INSULATION

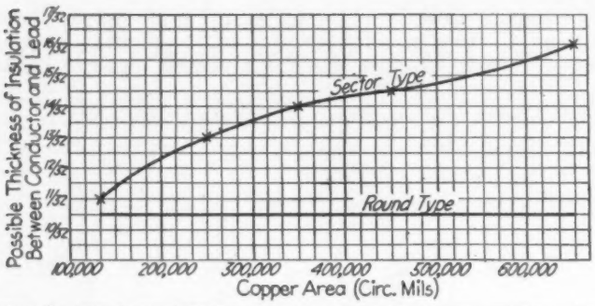


FIG. 4—POSSIBLE THICKNESS OF INSULATION IN SECTOR AND ROUND-CONDUCTOR CABLES HAVING SAME CONDUCTOR AREAS AND OUTSIDE DIAMETERS

cable insulated for 6600 volts, that probably being the type most commonly required by central-station companies. For lighter insulation walls the advantages of sector cable become more marked, while for heavier walls the reverse is true. With ordinary wall thickness sector cable possesses no practical advantages for sizes smaller than No. 000, because the theoretical gain which

DATA ON SECTOR CABLE USED BY FIVE LARGE ELECTRIC-SERVICE COMPANIES

Name of Company	Amount (Ft.)	Service (Voltage)	Thickness in 32nds of Inch of Insulation Around		Conductor Cross-Section (Circ. Mils)	Carrying Capacity (Permitted)
			Each Conductor	Insulated Conductors		
New York Edison Company[1]	459,360	8000 Same to cable shell	5½	5	350,000	3500 kva., with 50 per cent overload for one hour at 6600 volts
	163,680	15,000 Same to cable shell	7	7	350,000	6000 kva., with same percentage of overload rating
United Electric Light & Power Company	19,324.50	7,500	5½[2]	5	350,000	
	14,127.10	7,500	6½[3]	5½	350,000	
	3,861.20	7,500	7[4]	7	350,000	
	141,472.51	15,000	7[5]	7	350,000	
	910.00	15,000	8[6]	8	350,000	
	72,284.10	23,000	8½[7]	4	350,000	
	2,730.00	23,000	8[8]	8	350,000	
	258,081.419					
Public Service Electric Company of New Jersey	200,000	13,500	6	6	350,000	7500 kva.
Brooklyn Rapid Transit Company[10]	209,668	6,600[11]	6	6	350,000 2.78 to 2.89 in. outside diameter	
Detroit Edison Company	64,416	4600-volt trunk line	5	5	450,000	3000 kva.[12]
	11,616	4800-volt distribution to overhead lines	5	5	450,000	3000 kva.[12]

[1]Specifications call for thirty-seven strands per conductor. Thickness of sheath is ¼ in. Alternating-current test voltage for five minutes between conductor and ground, 25,000 volts, and between conductors, 25,000 volts.
[2]7500 volts between conductors and sheath.
[3]In generating stations and substations to afford additional reliability.
[4]In generating stations to permit changing to 15,000-volt service.
[5]15,000-volt service, same pressure to sheath.
[6]15,000-volt submarine section to permit changing to 23,000 volts.
[7]23,000 volts half voltage to sheath.
[8]23,000-volt service, submarine section.
[9]Includes 3372 ft. of odd sizes representing older practice.
[10]Specifications call for forty-nine strands per conductor, the diameters of the individual strands being largest at the cores of the conductors and graded off toward the outside to permit flexibility and maintenance of the sector shape. Tin is not specified in the lead sheath. Break-down test between each of two conductors and the other two connected to lead sheath of 30,000 volts for one-half hour (at factory) and 23,000 volts for ten minutes (after installation). Limits of insulation resistance in megohm miles, 100-400 corrected to 15.5 deg. C.
[11]Cables are designed for 11,500 volts to permit changing to that pressure in the future.
[12]This low rating has been given because the 450,000-circ. mil cables are mixed in with heavily loaded 200,000-circ. mil cables, so it is necessary to restrict the loading on the larger ones to about 350 amp. to prevent high temperatures in ducts.

SPECIFICATIONS OF PUBLIC SERVICE ELECTRIC COMPANY OF NEW JERSEY FOR 13,500-VOLT PAPER-INSULATED CABLE AND COVERING SECTOR CABLE

GENERAL DESCRIPTION.—The 13,500-volt alternating-current feeders shall consist of three conductors properly insulated and sheathed. All labor and material employed in its manufacture shall be of the best quality, appropriate for the purpose intended, and shall conform to these specifications:

CONDUCTORS.—The conductors shall be of soft-drawn[1] Lake Superior[2] copper having a conductivity of not less than 98 per cent, Matthiessen's[3] standard. All conductors shall be stranded concentrically. The number of strands is given below, and the size of strand shall be sufficient to make the cable of full capacity:

	Strand
No. 4 and No. 2 B. & S. gage	7
No. 1 to No. 00 B. & S. gage	19
250,000-circ. mil	37
350,000-circ. mil sector-shape conductor	39

INSULATION.—Each conductor shall be insulated with paper strips properly saturated with compound, wound spirally,[4] and overlapping to a thickness of 7/32 in. The conductors shall be laid together spirally with jute laterals to make the whole cylindrical. Over the conductors thus laid shall be wound as above described a jacket of paper 7/32 in. in thickness, thoroughly saturated with compound. The above applies to all sizes of cable from No. 4 to No. 00 B. & S. gage. The 250,000-circ. mil and 350,000-circ. mil gage cable shall be insulated with 6/32 in. over each conductor, and a jacket of 6/32 in. Otherwise same as above.

SHEATH.—The sheath shall be composed of commercially pure lead alloyed with 1 per cent tin and shall not be less than 4/32 in. in thickness.

FACTORY TESTS.—Before leaving the factory the cable shall be subjected to the following tests, to be made in the presence of a representative of the purchaser, the manufacturer supplying all necessary apparatus:

First—A test for copper resistance which shall conform to previous specification.

Second—A test break-down at 30,000 volts, alternating for five minutes, the current being supplied by a transformer of sufficient size. The test voltage is to be applied between all three conductors and between conductors and lead sheath.

Third—A test for insulation resistance which shall be required to be not more than 500 or less than 50 megohms per mile, at 60 deg. Fahr., after one minute's electrification, using a battery of not less than 100 volts. There shall not be a variation of more than 100 megohms between different sections of cable applying on the same order.

Fourth—In every ten reels one section, to be selected at random by the purchaser, is to be subjected for five minutes to double working voltage applied between all three conductors and between conductors and lead sheath, at a temperature of 150 deg. Fahr. and after cable has been immersed in water forty-eight hours.

Fifth—Samples from 10 ft. to 25 ft. long and selected by the purchaser at random from any cable lengths shall not break down under five times working pressure applied for five minutes between all three conductors and between conductors and lead sheath, after samples with ends sealed have remained at a temperature of 150 deg. Fahr. for 100 hours in straight, single lengths, with axis inclined 15 deg. to the horizontal.

Sixth—A sample from any length of cable shall be bent around a cylinder having a diameter equal to fifteen times the outside diameter of the cable over the lead sheath and then be straightened out. It shall then be bent in the opposite direction around the cylinder and then straightened out. This operation shall be performed twice in succession, after which the cable shall be capable of withstanding a voltage test two and a half times working pressure applied for a period of five minutes between conductors and between conductors and lead sheath, and shall show no signs of cracking or other mechanical or electrical injury when dissected.

TEST AFTER INSTALLATION.—In case the cable is bought installed, the following test of the finished cable in the conduit shall be made before acceptance:

The cable shall stand a break-down test of 25,000 volts alternating for ten minutes, the current being supplied by transformer of sufficient size.

GUARANTEE.—The manufacturer shall guarantee that the outside diameter of finished 250,000-circ. mil cable will not be more than 2.66 in. and 350,000-circ. mil sector cable will not be more than 2.7 in., and that same can be satisfactorily installed in 3-in. (inside diameter) fiber duct.

All cable shall be guaranteed at working pressure for a period of five years. Any cable failing within said time from any cause other than mechanical injury, electrolysis or lightning shall be replaced by the manufacturer.

[1]Some engineers specify "soft-annealed" copper based on the consideration that the drawing process hardens the conductor and it must be softened by annealing.
[2]Lake Superior copper is preferred by some engineers for hard-drawn aerial lines, but it has few advantages over electrolytic copper when annealed for insulated cables and its cost is higher.
[3]Instead of the Matthiessen standard of conductivity, the annealed copper standard adopted by the A. I. E. E., 1914, is now more frequently specified, and it is seldom that the conductivity of large untinned strands falls below 99 per cent.
[4]Some specifications call for paper wound "helically," not "spirally," with the conductors also laid "helically."

For specifications dealing with the quality of paper the recommendations of the Association of Railway Electrical Engineers may be consulted.—EDITOR.

can be shown for cable as small as No. 00 is offset by the practical difficulties met in attempting to maintain the sector shape of the conductors when forming the cable.

While ratings have been given to certain sizes of cables in the tabulated data, showing the practices of the large users of sector cable, it should be remembered that the same ratings cannot be given in all cases, for they depend on the opportunity which the cable has for radiating heat. For instance, cables in the center of a duct nest containing several other heavily loaded cables will not have so good an opportunity of operating at low temperatures as cables near the outside. Again, steam pipes in the vicinity of cables will lower their carrying capacity. Likewise, dry soil or duct-nest covering of low heat conductivity will prevent operating cables at maximum rating. Exposure to the direct rays of a summer sun has also been known to reduce the safe operating rating of underground cables. On the other hand, exposure of the ducts to extreme cold, running water, or any good heat-conducting medium, will permit operating cables at higher ratings. When it is not practicable to measure the actual temperatures of cable conductors with thermocouples or similar appliances, it may be safe to assume that a sector cable will radiate at least as much heat safely as the round-conductor cable which it may replace or which is installed under similar conditions.

The Excitation of Synchronous Machines—II

Phase Characteristics of the Synchronous Motor, Effect of Changes in Exciter Voltage on Power-Factor, and an Analytical Method of Computing Line Current Drawn

BY THEO. SCHOU

IN the first section of this article, which appeared in last week's issue of the ELECTRICAL WORLD, the operating characteristics of synchronous machines were discussed and practical data given on excitation requirements, including curves showing ratio of exciter ratings to those of alternators and the field currents of generators having various ratings and synchronous speeds.

Thus far the discussion has been confined largely to alternators. The excitating curves apply, of course, equally well to synchronous motors operating at leading or unity power-factor. The fact that the synchronous motor may be operated at leading, unity or lagging power-factor by varying its excitation makes it a very interesting machine, and its properties as power-factor corrector were discussed in detail by the writer in the Nov. 20, 1915, issue of the ELECTRICAL WORLD.

The electrical properties of the synchronous motor are so splendidly demonstrated and simplified in the V curves showing its phase characteristics that the writer deems it advisable to discuss them. Fig. 10 gives the tested V curves of a 20-kva., 360-r.p.m. synchronous motor, the commercial test sheet of which is reproduced in Fig. 11. The phase characteristics are curves showing the minimum value of the armature current when the motor is carrying a certain kilowatt load at a certain field excitation. They are V-shaped curves, being more and more pointed the less kilowatt or mechanical load the motor is carrying. When the synchronous motor is carrying a certain mechanical load and its field current is regulated to draw minimum amperes from the line at this load, then the motor is operating at unity or 100 per cent power-factor. The V curves show that there is a very small variation of field current at different loads at 100 per cent power-factor. Furthermore, as the V curves become flatter and flatter at increased load they show that the higher the synchronous reactance (and thus the armature reactance of the synchronous motor) the less sensitive is the synchronous motor to a change of field current or of impressed emf.

Another interesting feature shown by the no-load V curve is the value of line current a synchronous motor will draw with no field excitation. Referring to Fig. 10, the motor would draw approximately 24 amp., or 125 per cent of normal amperes, when running at synchronous-speed full voltage but no field excitation. This line current it is of interest to know, because it is the current the motor will draw from the line after being started up and reaching synchronous speed but before the field switch is closed. Knowing the saturation curve at no-load and also at full-load current at approximately zero per cent leading power-factor, the line current drawn by the motor at synchronous speed but no field excitation may be found by construction in the following way: The full-load current saturation curve at approximately zero per cent lagging power-factor (Fig. 11) may be found by moving the triangle $a_1b_1c_1$, equivalent to triangle abc, that represents the same quantities already discussed in Fig. 2, in such manner that point c follows the no-load saturation curve and the base line bc always remains horizontal. The intersection of the full-load current saturation curve at approximately zero per cent lagging power-factor with the ordinate representing the voltage axis evidently gives the impressed emf. at which the motor would draw normal current from line with no field excitation. If line $a'_1c'_1$ is drawn parallel to line a_1c_1 through the normal voltage point on the voltage axis, then the line current

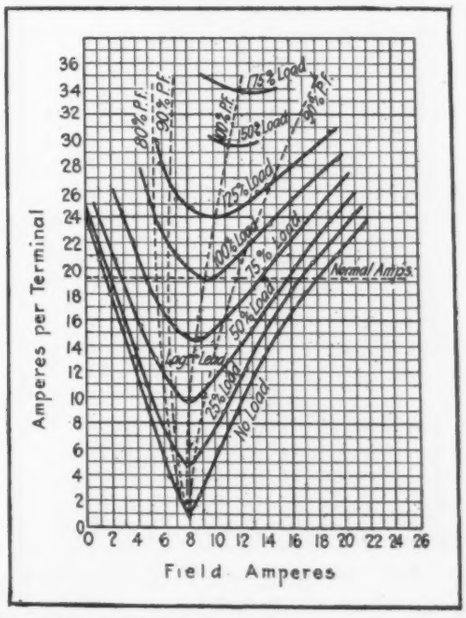


FIG. 10—FIELD CURRENTS REQUIRED TO MAINTAIN CERTAIN POWER-FACTORS AT DIFFERENT PERCENTAGES OF RATED LOAD

the motor would draw at normal voltage but with no field excitation would be $a'_1c'_1 \div a_1c_1$ times normal amperes.

Neglecting the saturation of the magnetic circuit, a synchronous motor running on any voltage at synchronous speed without excitation will draw a current from the line equal to the short-circuit current when run as a generator with field excitation corresponding to the above-mentioned open-circuit voltage. Should the synchronous motor take its excitation from the generator system exciter busbars, which are regulated by a Tirrill regulator, then it can easily be computed what will happen to the operation of the synchronous motor if the excitation voltage should drop or rise in value, which will occur during load changes on the generating system.

For example, referring to Fig. 10, the motor, when operating at 100 per cent power-factor, with a power output of 100 per cent of normal, has a field current of 9.5 amp. Should now the excitation voltage drop 28 per cent, or the voltage of the exciter busbars drop from 125 volts to 90 volts, and the setting of the field rheostat and the power output of the synchronous motor remain unchanged, the field current of the motor will drop to 6.8 amp. The motor would draw 21.4 amp. from line or operate at full power output at approximately 90 per cent lagging power-factor. Similarly, with a rise of the exciter voltage, the motor, carrying the same mechanical load as before, would settle down to operation at a certain leading power-factor.

If the synchronous motor be excited from its own exciter, either directly driven or belt-driven, then the excitation voltage of the motor would not be disturbed unless the frequency of the line current should change.

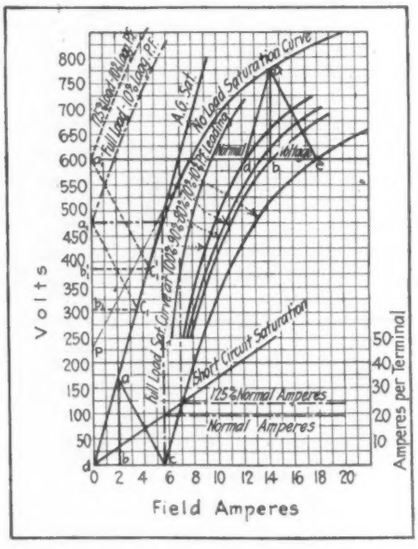


FIG. 11—CONSTRUCTION FOR ANALYTICALLY COMPUTING LINE CURRENT FROM SATURATION CURVES

If frequency and excitation voltage remain constant and the field excitation of the synchronous motor be set for full-load 100 per cent power-factor, then if the load should vary on the motor its power factor would vary as shown in Fig. 12.

If the synchronous motor be installed at the end of a long transmission line with or without step-down transformers at the plant, it is then obvious, barring resonance effects, that the receiving voltage at the motor end is considerably lower than the generating station voltage, owing to the impedance drop in the line and the regulation of the transformers. The synchronous motor might or should in this case be over-excited to

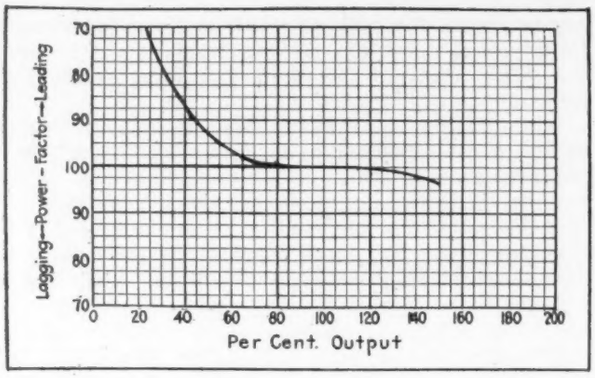


FIG. 12—EFFECT OF CHANGE OF LOAD ON POWER-FACTOR OF SYNCHRONOUS MOTOR EXCITED TO GIVE UNITY POWER-FACTOR WITH FULL LOAD

compensate for this voltage drop, and, in fact, synchronous motors are used as voltage regulators at the receiving end of the line. If the impedance drop of the line be heavy and the motor subjected to fluctuating power load, then its excitation might be regulated by a Tirrill regulator, keeping constant voltage at the terminals. In regulating the excitation of a synchronous motor with a Tirrill regulator it is to be recommended that exciters of the laminated-pole construction and with interpoles be used, as exciters of this construction will more readily respond to the instantaneous exciter voltage change, a feature needed for synchronous motors.

Cardinal Principles of Federal Water-Power Policy

In a paper outlining a federal water-power policy for the public lands of the United States, read before the recent Pan-American scientific congress, O. C. Merrill, chief engineer of the Forest Service, Department of Agriculture, names as the cardinal principles underlying such a policy: Prompt and complete development and continuous use of power sites upon the public lands; the limitation of valuations to reasonable cost for both rate-making and public purchase; the protection of the investment by certainty of tenure and reasonable conditions of occupancy; the re-capture of the properties for public use at the termination of the lease, and the reservation of power rights in all lands suitable for power use.

In carrying out such a policy, he declared, there is no duplication of the functions of the several states—only the exercise of powers which the states do not possess. In performing these functions the federal government would act as a proprietor, not as a sovereign, and would supplement, not supersede, the state.

Of all the elements that enter into the cost of a power system, the only one that can be altered by legislation, it was pointed out, is the cost of capital. To secure cheap capital and to reduce the investment to a point where favorable rates may be granted it is necessary to protect the investment and to provide conditions under which reasonable returns may be assured. Certainty of tenure for a period sufficiently long to realize the expected profits upon an enterprise is one of the prime requisites of cheap capital. The main defect in the existing law is its apparent uncertainty of tenure, but certainty of tenure requires neither a patent nor a perpetual grant. All the protection that capital needs, all the capital that development requires, can be secured under long-term leases accompanied by reasonable conditions of occupancy, without any sacrifice of the public interest.

STATION AND OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Underground Distribution System at Calgary, Canada

Description of the Layout of Large Feeders, Transformer Manholes, and Secondary Network

By J. N. LIGHTBODY

In the city of Calgary, Canada, light and power service from the municipal system is furnished by underground distribution in the down-town district. Only alternating-current service is supplied at 220 volts for power and 110 volts for lighting. In cases where a building has direct-current elevators, the building owner installs a motor-generator set. The area served

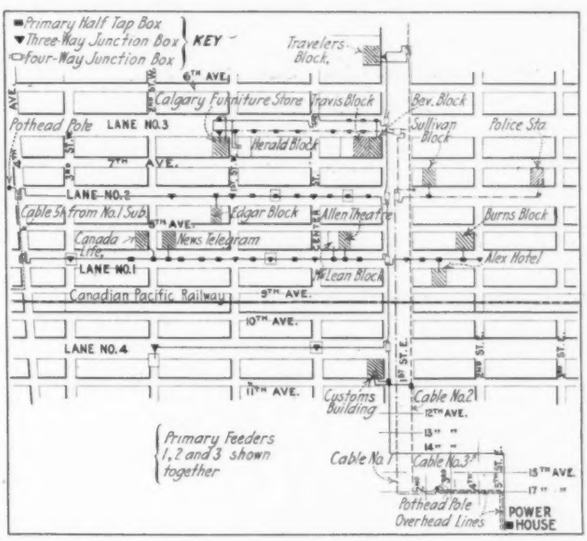


FIG. 1—LAYOUT OF FEEDERS IN AREA SERVED

underground is about 0.25 sq. mile. The feeder circuits are shown in Fig. 1. The power house is situated about 0.5 mile from the center of distribution. The three main feeders are indicated, together with the different junction boxes and transformer locations. The district is also supplied with an emergency feeder from substation No. 1. There are fifteen transformer installations and five transformer manholes, with 2000 kva. in power and 900 kva. in lighting transformers installed.

Distribution is entirely from a lane system. Briefly, the system consists of a bank of transformers in a manhole in the lane or in the basement of some building near the center of the block, with underground lighting and power mains running the full length of the block and service cables running up the side of a building to a cross-arm and the regular service leads connected to this arm. This method is used where the load is well distributed. Large buildings which require considerable power themselves have their own transformer rooms. The system is not strictly an underground one; however, it eliminates all poles and primary wires, only the service connections being left to interfere with fire fighting and the like. In Fig. 2 the service cables up the side of a building are shown with the service leads connected to the cross-arm above the disconnecting-type potheads.

In the location of manholes and the arrangement of laterals of the conduit system for the district served underground the conduit is installed on a line 5 ft. from the property line in a 20-ft. lane. Single or multiple clay duct four deep and four wide is standard in the lanes, with a 4-in. concrete sub-base, reinforced with two 0.5-in. steel rods and a 3-in. concrete envelope. Single-way clay duct is largely used in preference to multiple duct because when excavations for other utilities or for a building are made the conduit line is easily repaired with split duct if it is injured by the excavation. Laterals are either iron or fiber conduit laid on top of the main duct line. The iron conduit is not surrounded with concrete, only the joints being steadied with a few shovelfuls. The fiber laterals are incased in a thin concrete envelope.

Transformer manholes are 10 ft. by 12 ft. by 7 ft. 6 in. high, while the others are 6 ft. by 7 ft. by 6 ft. 3 in. high. They are all made entirely of concrete with the roofs reinforced with old steel rails and 0.5-in. steel bars in the usual way. Manholes are drained by a sump hole filled with gravel which carries the water away very successfully and saves the expense of sewer connection. Rectangular cast-iron covers 3 ft. 3 in. by 2 ft. 3 in. (clear) are used on transformer manholes, and a 26-in. round cover on the others. The rectangular covers have proved to be hard to handle in case of trouble, and in a later design a round cover has been inserted in the middle of the rectangular one. Only the round cover need be used except when transformers are to be lowered into the manhole.

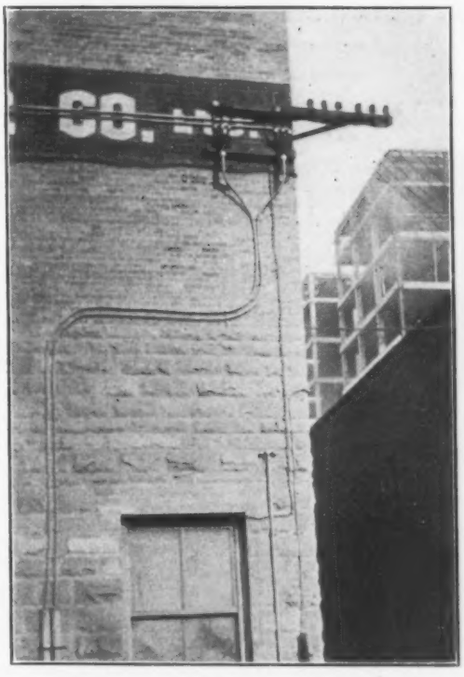


FIG. 2—CONNECTIONS OF UNDERGROUND CABLES WITH OVERHEAD LINES, SHOWING USE OF DISCONNECTING-TYPE POTHEADS

The three-phase, three-wire, 2300-volt primary system is shown in Fig. 1. All feeders are 300,000 circ. mil and are interconnected with G. & W. primary junction boxes in such a way that any lane can be fed from any one of the four feeders and can be sectionalized for repairs. No manhole-type oil switches have been used yet. To "kill" any section of primary cable the load on it is first disconnected, and then the tubes on the primary junction box controlling the section are pulled. The diagram shows half tap boxes installed at transformer manholes. Recently three-way boxes have been used at this point so that the primary feeder can be sectionalized and the transformers fed from either end.

In Fig. 3 a cross-section of a typical transformer manhole is shown. The ordinary pole-type transformer mounted on a concrete pedestal has been used so far and no trouble from flooding has been encountered. The secondary leads from the transformer enter disconnecting-type potheads and run in cable to the low-tension junction boxes bolted to the manhole wall, so that no moisture can enter the cable. A tap is taken from the primary junction box to a pot-head connected with buses mounted on pipe work over the transformers. Oil-fuse cut-outs protect the transformers on the primary side, while no fuses are used on the secondary side. This type of transformer manhole has not been accepted as standard but has given good service so far. It is probably not much cheaper than one in which manhole-type transformers are used and all connections are made with cable.

In Fig. 4 a diagram of the secondary system is shown. The mains are usually 300,000 circ. mil in size. Adjacent secondary networks are connected by a tie-in junction box the links of which can be used to tie in the two networks in case of trouble. Two types of low-tension junction boxes are used, the G. & W. six-way box, which can be used for either lighting or power, and a locally designed six-way box, which can be used for either lighting or power or a combination of the two services.

When a new building is erected, the architect allots, free of charge, a corner in the basement, and the electric-light department fits up a fireproof room with tile walls and asbestos ceiling. Ordinary pole-type transformers are used with oil-fuse cut-outs. A few of the

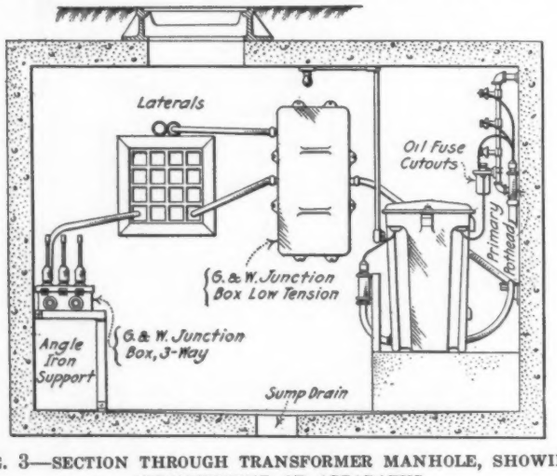


FIG. 3—SECTION THROUGH TRANSFORMER MANHOLE, SHOWING ARRANGEMENT OF APPARATUS

largest transformer rooms—for example, one in the Herald Building of 400-kva. rating—have double-throw automatic oil circuit-breakers on the primary side of the transformers and low-tension distributing boards on the secondary side. Taps from two primary feeders are supplied so that the transformers can be connected with either of two sources. Cramped conditions and poor ventilation are two difficulties met with in building transformer rooms. Transformer neutrals are grounded on water pipes in buildings and to Paragon ground cones when the transformers are installed in manholes.

Records for the use of troublemen are kept in the form of maps of each secondary network bound in sec-

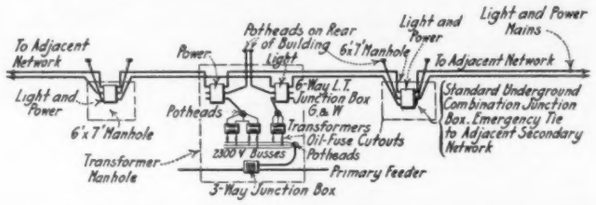


FIG. 4—DIAGRAM SHOWING MANHOLE CONNECTIONS TO SECONDARY NETWORK

tional map covers. The maps give a simple diagram of the network and a wiring scheme of the transformer room supplying it. Load and test records are kept on separate card systems. R. A. Brown is electrical engineer of the city of Calgary.

Simple Rules for Securing Satisfactory Transformer Operation

Companies that cannot afford to conduct elaborate periodic tests on transformers may find it advantageous to follow the simple inspection practice of the Northern Ohio Traction & Light Company, Akron, Ohio, as outlined by W. E. Salber, superintendent of lines, at a recent committee meeting of the Ohio Electric Light Association. Before a transformer is put in service the case is opened to make certain that bushings are not broken and that the terminals are tight and not too close to the case. If they are not separated sufficiently therefrom, a sheet of "micarta" insulation is placed over them and attached to the terminal block. To bring out defects in insulation, twice operating voltage is applied between coils and the case for half an hour. When several units must be connected in parallel their voltage ratios are tested to ascertain whether they will share the load properly. Presence of excessive moisture in the oil is determined by dropping some on a hot metal plate. If it boils away and dries up it is considered satisfactory, but if it sputters it is dried before using. The oil is usually dried and purified by heating and filtering through gravel.

After transformers are placed in service, they are watched to see that water does not collect in the oil by siphoning off a sample from the bottom periodically and taking it to a central point for testing. Portable oil tanks and pumps are being developed by this company, so that when oil needs replacing it may be easily done by drawing off the old oil and pumping fresh oil into the case. With large transformers this is usually done about every six months. Ordinary distribution transformers, however, are refilled with oil only about once in three or four years.

In discussing this subject A. O. Austin, chief engineer of the Ohio Insulator Company, pointed out that transformers with windings high up in the case are less liable to give trouble from burn-out than those with lower-placed coils, since any moisture which collects in oil will usually settle to the bottom of the case. For this reason oil samples should always be taken from the bottom of the case. Since oil is usually depended on for filling up insulation punctures, it usually pays to purchase the best of oil even for small transformers, especially when they are subject to frequent

lightning disturbances. Oil will remain in better condition when the transformer operates at uniform load than when there are large fluctuations in temperature, for then the transformer will "breathe" (owing to the consequent expansion and contraction of the oil) and draw air into the case, where the reduced dew point will cause moisture to condense.

Attention was also called to the fact that sulphur in oil will corrode wire leads, causing them to separate and possibly to short-circuit. As a check on the presence of moisture in oil it was suggested that megger readings be taken periodically to ascertain whether the insulation resistance is increasing or decreasing. Under any condition oil should be strained before using. An inexpensive filter may be made of several thicknesses of cheesecloth when nothing better is available. It was pointed out that moisture may also get into the original containers shipped by manufacturers, owing to their breathing action, if any leaks are present or if the valves are not absolutely air-tight.

A Construction to Make Battery-Room Floors Impervious to Acid

The construction of battery-room floors has been carefully studied by the New York Edison Company, the accompanying illustrations showing a floor construction now used. Briefly, the floors are made impervious to acid by a covering and are graded so that they will drain toward one side where a gutter is provided which empties into a lime box. The latter is employed to neutralize any acidified water which may be collected before it is discharged into the sewer.

The acid-proof coverings are laid on ordinary concrete floors reinforced by steel girders. Over this a 1:2:4 mixture of concrete with a cement-mortar finish is placed. The surface is then painted with hot "Hydrex" compound and covered with three layers of butt-jointed acid-proof Hydrex felt, the strips being run with the flow line of the room. The joints are bonded with hot compound. Around the borders and under the drain box additional layers of felt and compound are employed.

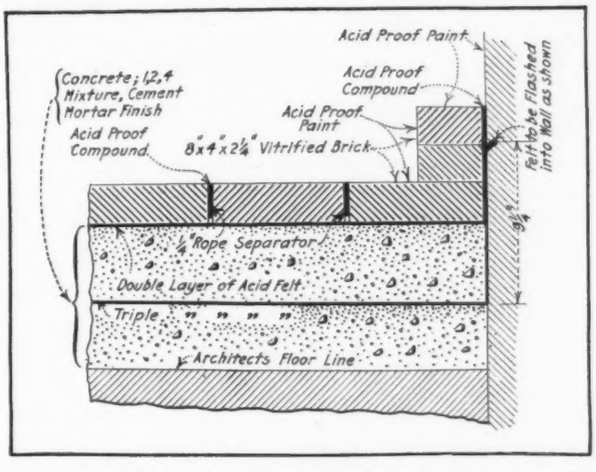

Acid Proof Paint
Concrete; 1:2,4 Mixture, Cement Mortar Finish
Acid Proof Compound
Acid Proof Compound
Acid Proof Paint
8"x4"x2¼" Vitrified Brick
Felt to be Flashed into Wall as shown
¼" Rope Separator
Double Layer of Acid Felt
Triple " " " "
Architects Floor Line

FIG. 1—BATTERY-FLOOR CONSTRUCTION NEAR WALL, SHOWING LAYERS OF CONCRETE SEPARATED BY ACID-PROOF COVERINGS WITH A BRICK SURFACE

A second layer of 1:2:4 concrete is placed over all, finished and painted like the first, and covered with two crossed layers of acid-proof felt. Laid on this with their longest dimensions in the direction of the flow line of the room are 8-in. by 4-in. by 2.25-in. vitrified bricks, the spaces between which are filled with 0.25-in. rope separators and hot compound. The thickness of the first layer of concrete is tapered from the gutter to the opposite side of the floor to give the finished floor an 0.8 per cent grade. The gutter in turn is given a 0.5 per cent grade. The minimum thickness of the floor is made about 9⅛ in.

Where the acid-proof covering must pass over girders they are first covered with neat cement and a sheet of

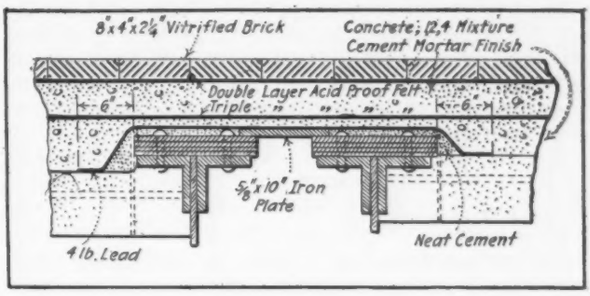


FIG. 2—METHOD OF PROTECTING STEEL GIRDERS WITH CEMENT AND SHEET LEAD

lead, as shown in the accompanying drawing. Around the edges of the floors for the battery rooms are built low barriers of vitrified brick coated with acid-proof paint and separated from the walls by Hydrex felt and hot compound.

How a Basis May Be Established for Comparing Over-all Power-Plant Efficiencies

H. A. COZZENS, JR.

A turbine may show a higher efficiency in operation from month to month by a decrease in the water rate, or a condenser may show an increase in the vacuum, in such a way as to create the impression that the plant efficiency is much higher for one month than for another. On the other hand, in the boiler room the losses may have increased to such an extent as to counteract any material gain in other portions of the plant. It is better practice, therefore, to select some other means of evaluating the plant efficiency than on that of the individual parts. With this end in view, it is common practice to state the number of pounds of coal used in generating a kilowatt-hour as a standard in speaking of plant performance.

This involves the coal as the raw material and electrical energy as the finished product. The chief end in a power plant, as in any factory, is to obtain the highest amount of finished product from a minimum outlay of raw material. If records are kept showing this relation, a true account of the performance is at hand. Such records will include all losses which might be overlooked if the individual efficiency of each machine were taken as a standard. From the figure expressing the coal used per kilowatt-hour it is a simple matter to compute the power-plant efficiency as the over-all efficiency of the station as a unit.

This efficiency is the continuous product of the efficiencies of the various elements. For instance, assume that in a plant the boiler has an efficiency of 74 per cent, the turbine an efficiency thermally of 14 per cent, and that the mechanical and electrical efficiencies of the turbine and generator are 90 per cent and 95 per cent respectively. The over-all efficiency would then be $74 \times 14 \times 90 \times 95$, or 8.86 per cent.

It is apparent that by this method no allowances are made for the links which bind these different elements together; hence it is better to express the efficiency as involving the whole operation of producing electricity. An expression for this efficiency would be:

E = (heat value of 1 kw.-hr.) ÷ (heat in coal to produce 1 kw.-hr.) = 3415 ÷ (coal per kw.-hr. × B.t.u. value of coal).

For example, in a plant where the coal used per kilowatt-hour is 2.51 and the average heating value of the coal for the same period is 14,160 B.t.u., a substitution of these values in the expression gives:

$E = (3145 \times 100) \div (2.51 \times 14{,}160) = 9.59$ per cent.

This figure then represents the thermal efficiency of the plant. Records may be kept stating this efficiency over selected time elements and constant attention paid to increasing this figure. Any serious deviation from preceding figures for like periods should be the basis of an investigation.

How a Condenser Was Used to Remove Water That Interfered with Excavation

BY A. V. WYNNE

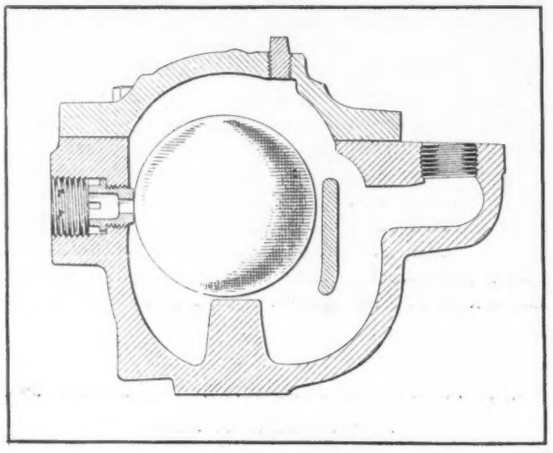
Water and quicksand are always sources of trouble when an excavation is made at the plant site of the Massillon (Ohio) Electric & Gas Company. The latest trouble was encountered when the company's workmen began to excavate for the foundations and condenser pit of a new 6000-kva. turbo-generator. In this case, to remove the water, a sump in the excavation was connected by a 4-in. pipe line with the Le Blanc condenser of a 2000-kw. machine already operating in the station. The condenser took its cooling water from the pit through this pipe instead of from a nearby canal. As the pit was excavated the pipe line was lowered by adjusting a double-L connection placed in the line for this purpose. This scheme, besides providing an inexpensive means of lifting the water, possessed a further advantage in that it provided the condenser with colder circulating water than it was possible to obtain from the canal.

A Simple Design of Steam Trap That Handles High Rates of Discharge

The accompanying illustration shows a type of steam trap originally designed by Charles S. Brown, professor of mechanical engineering at Vanderbilt University, Nashville, Tenn., for use on a large oil separator on the exhaust line leading from the university power plant and supplying steam to a vacuum heating system. The device constructed for this purpose consisted of a 5-in. copper float operating on a discharge nozzle containing a ⅜-in. orifice. It was installed on the separator in October, 1908, and has been in successful operation ever since.

This type of steam trap as now designed is used in connection with apparatus where the rate of discharge of condensate is very high, as well as on heating-system lines and the like. Mechanically the device is the equivalet of the ordinary float trap, with its lever, fulcrum and valve. The float itself is the valve, while its radius is the lever at the end of which the force produced by the buoyancy of the float may be considered as concentrated. The fulcrum is at the upper edge of the orifice about which the float rolls. The valve proper is that portion of the float covering the orifice, and its lever arm is the orifice radius. These relations are clearly shown in the accompanying illustration.

The device operates against heavy pressure even with floats of small size and orifices relatively large. A float 4 in. in diameter, constructed of such thickness of metal as to float one-half submerged, would, when free, weigh about ½ lb. and would have to be loaded with ½ lb. in order completely to submerge it. The ½ lb. is therefore the buoyancy of the float. This acts as if concentrated at its center of gravity (the center of the float), and through a lever arm which, with respect to the top edge of the orifice, is equal to the radius of the float, or 2 in. The moment of this buoyancy with respect to this point is therefore ½ lb. times 2 in., or 1 in.-lb. If it be



SECTION THROUGH A DESIGN OF STEAM TRAP WHICH CONSISTS ESSENTIALLY OF A BALL FLOAT AND DISCHARGE ORIFICE

assumed that the diameter of the orifice is ¼ in., the area of such an orifice is about 1/20 sq. in. A pressure of 160 lb. per square inch in the trap would produce a pressure of one-twentieth times 160 lb., or 8 lb., on the area of the orifice. This pressure of 8 lb. on the orifice acts as if concentrated at the center of gravity, that is, its center, which is ⅛ in. from the edge of the orifice. The moment of the orifice pressure is 8 lb. times ⅛ in., or 1 in.-lb. This is exactly equal to the moment of the float with respect to its fulcrum. In other words, the maximum capacity of a 4-in. float to operate on an orifice ¼ in. in diameter would be reached when the pressure within the trap was 160 lb.

In this type of rolling-float trap a proper proportioning of the face of the nozzle containing the discharge orifice makes it possible to discharge air automatically through the orifice even when the operating water lever is considerably above the orifice. The trap is self-adjusting because the hollow spherical ball as the operating part naturally seeks the point of least pressure, which is the orifice. It is relatively powerful even in very small sizes because of its lateral position with respect to its discharge orifice, in which position the float can exert a maximum effort in opening the discharge port. The action of the hollow float on the plain surface of the discharge nozzle is a rolling one, and therefore practically frictionless. Its simple design makes it a durable piece of apparatus and one free from repairs.

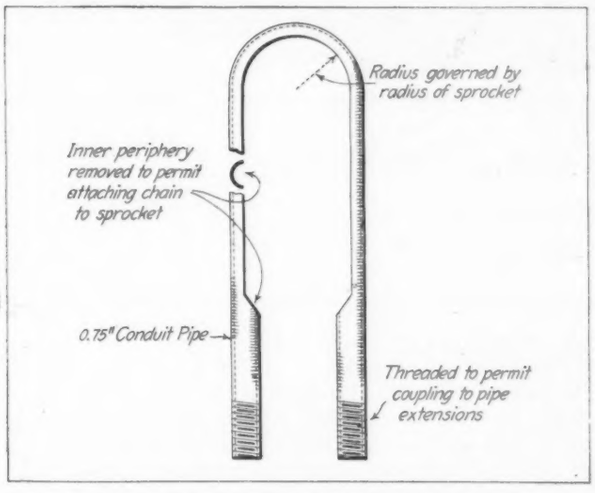
The Results of Boiler-Water Treatment in an Ohio Station

Several years ago, when the Coshocton (Ohio) Light & Heating Company was using untreated deep-well water in its boilers, considerable trouble was experienced due to boiler scale and burning out of tubes. A soda-ash treatment by means of suitable equipment is now used, and scale troubles have been entirely eliminated. No tubes have been lost in the past two years and cleaning is required only at long intervals. To treat the water only 16 lb. of lime and 20 lb. of soda ash are used per 10,000 gal. of water employed. These

substances are mixed with the water by mechanically driven agitators, after which the water is allowed to stand two hours for sediment to settle. According to the electric-service company, the water-softening apparatus requires only fifteen minutes of labor each day. The softening apparatus employed is known as "We-Fu-Go" and manufactured by Wm. B. Scaife & Sons Company, Pittsburgh, Pa.

An Easily Made Guard for Rheostat-Operating Chains

If the chains or steel cables which are usually employed to connect manually operable rheostats with the controlling handwheel on the switchboard break and exposed conductors are in the vicinity, serious results may occur from a short-circuit. Trouble from this source may be prevented, however, by inclosing the chain with pipe attached to the switchboard or frame. To permit inclosing the chain-contact periphery


Radius governed by radius of sprocket
Inner periphery removed to permit attaching chain to sprocket
0.75" Conduit Pipe
Threaded to permit coupling to pipe extensions

A GUARD FOR RHEOSTAT CHAINS MADE OF PIPE

of the sprocket wheels, as well as the chain itself, U-shaped pipe sections may be used with the inner half cut away as shown. It may be pointed out that the length of the section cut away should be at least five and one-quarter times the radius of the sprocket wheel to permit assembling and free operation. The U-shaped sections may be attached to the straight sections by union joints.

Use of Sulphur in Bushing Filler of Oil-Insulated Transformers

BY A. C. HEWITT

There seems to be some objection to the use of a plaster-of-paris and sulphur mixture for sealing transformer leads as described by the writer in the Nov. 13, 1915, issue of the ELECTRICAL WORLD, page 1091. The danger outlined by E. J. Hunt on page 1317 of the Dec. 11, 1915, issue lies in the possibility that the sulphur of the mixture will attack copper and finally destroy the windings. The writer has never experienced this trouble and at the time the mixture was used satisfied himself in regard to the matter by consulting with chemists. Since the possible danger mentioned has been emphasized, however, a number of manufacturers have been consulted who state that the use of such a mixture has been discontinued on account of possible trouble and that other sealing mixtures are used.

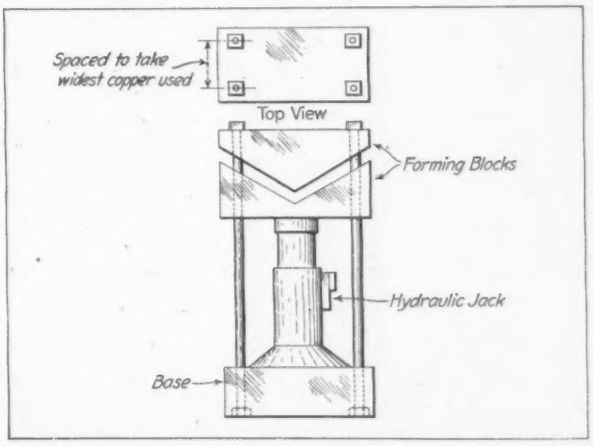
To determine the action of a mixture containing sulphur, the writer has conducted some experiments with the following results:

Six pieces of No. 2 B. & S. gage copper wire, which had been cleaned with dilute acid, washed and dried and their weights taken on a chemist's balance, were placed in small bottles and a small amount of sulphur was poured into the bottles. The copper was then covered with transformer oil. The samples were allowed to remain in the oil and sulphur from eighteen to forty-two days, when their weights were taken. The percentage of the total weight of copper which was removed by the sulphur was about 0.1. In each case there was approximately 6.5 sq. cm. exposed, and the action seemed to be the same whether the copper was in direct contact with the sulphur or whether it was in contact with the oil. The results of the experiment seemed to show that it makes no difference in regard to the length of time the samples were exposed to the action of the sulphur, as practically the same loss in weight was found with a sample which was immersed for only eighteen days as with a sample which was immersed for forty-two days. This may be accounted for by the fact that after about one day's time there was a black coating on the copper which very likely was copper sulphide, and this coating was found very tough and hard to remove. In fact, it was necessary to use emery cloth to clean the wire.

A Device for Shaping Busbar Copper

BY R. H. RICHARDS

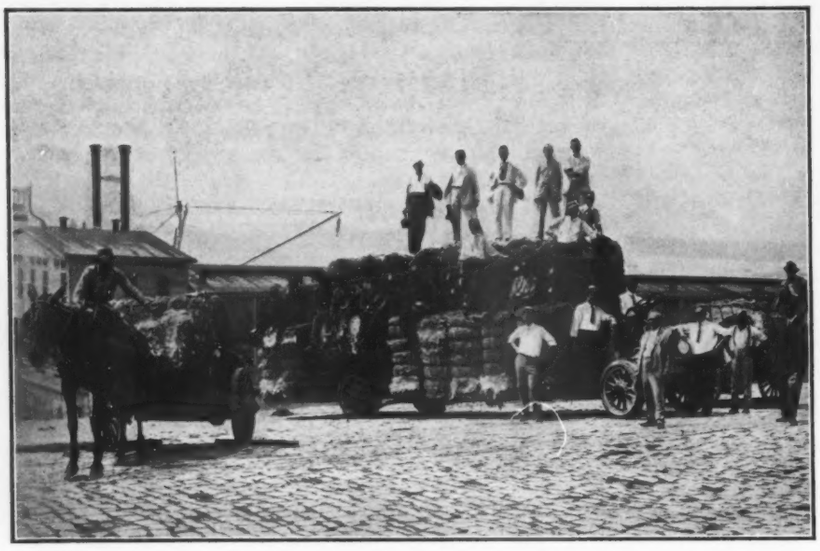
Shown in the accompanying drawing is a hydraulically operable device for bending strap copper such as is used in busbars. The upper part consists of two castings, the upper wedge-shaped and the lower V-shaped, so that when a bar is laid between them and the two blocks are forced together the bar will be bent to the angle of the wedge. To permit this operation the upper block is rigidly attached to but separated from the base plate by four through-bolts on which the lower forming block slides. Between the latter and the base plate is a hydraulic jack for forcing the two forming blocks together. The bolts being remov-



HYDRAULIC JACK USED TO OPERATE BUSBAR-FORMING DEVICE

able, forming blocks with different angles can be employed. For most busbar installations 90-deg. and 120-deg. blocks will suffice. With this apparatus the writer has been able to cut the cost of shaping busbars in half as compared with methods formerly used. Furthermore, the copper is not marred in the process of bending.

World's Largest Truck Load of Cotton Hauled Electrically at Memphis, Tenn.



The trucking of baled cotton on the levee at Memphis, Tenn., used to be the exclusive business of black men and mules. But lately electricity has stepped in there, as it has in so many other manual operations, and has changed a muscular task to one of machine work. The illustration shows the old and the new methods of hauling cotton. One man with a dump-cart and a mule can haul about three bales of uncompressed cotton per load, while the 6-ton General Motors Company electric truck is shown ready to take a rather steep grade with a load of twenty-five bales. On account of the size of the bales being handled this load is said to be the largest ever hauled by a motor truck. The officers of the Memphis Terminal Corporation, the owner of the truck, have expressed themselves as well pleased with its operation and declare that when conditions in the cotton market warrant it they will be prepared to operate a fleet of such electric trucks.

MARKETING ELECTRICITY

A Department on Selling Service and Widening the Use of Electrical Energy

Selling Electric Ranges in a City of 4000

The Psychology of Remitting the First Month's Bill for Electric Cooking During Successful Campaign at Glendive, Mont.

By Frank C. Hughes

Manager Glendive Heat, Light & Power Company

THE first electric range to be connected to the circuits in Glendive was sold in March, 1911. It was an experiment, for we wanted to see how it would appeal to the people in a city of this size. We have a population here of only 4000. We did not attempt to push the sale of this device at all, however, until last summer, and for two reasons. For one thing, we wanted to see what the local opinion was, for in a community of this size a single electric range will naturally become well known to a large number of households. Then, besides, conditions at the plant were not just right for taking on any amount of business that would add to the peak load, as we were well loaded and a bit afraid of the peak that we thought the range would bring. But early in 1915 our new plant was completed. Its rating was ample, and we decided to go ahead and try to put out as many ranges as possible.

The Terms and Conditions

We figured that a range would naturally increase our revenue from any home and therefore that it would be worth while to offer ranges at cost and make all possible inducements to customers to "try them out" in their homes. So we sold a few ranges at cost, with the customer paying for his wiring. We then determined to sell the stoves at our cost and furnish the wiring free, and to put the stoves in on thirty days' free trial, making a charge of $4 in case the customer decided not to keep the stove at the end of the trial period.

Our rate for energy consumed by electric ranges is at present 4 cents per kilowatt-hour, with a minimum of $1 a month, and we make a practice of not installing the meter until the end of the thirty days' free trial period because experience has shown that the first month's bill is inevitably the largest and this naturally will prejudice customers against the use of the electric range, for they will greatly overestimate what it is going to cost them to cook by electricity. After a month's use of the range the customer is able to cook with a smaller energy consumption than at first. We find that our average consumption per month per range is 100 kw.-hr.

The blank order which was filled in for these stoves read as follows:

Glendive, Mont., Oct. 15, 1915.

Glendive Heat, Light & Power Company, Glendive, Mont.:

This is your authority to install one Hughes electric range, No. ——, for thirty days' free trial, with the understanding that I am under no obligation to your company if at the expiration of thirty days I care to return the stove, and the only expense incurred will be $4 charge for installation.

On all orders taken during campaign the thirty days' trial consumption of electricity will be paid by the Hughes Electric Heating Company. The campaign price of this range is $——, installed. Orders taken now are for delivery not later than May 1, 1916.

The Methods and Results

We featured this range proposition right through the fall and up to Christmas, advertising it in the newspapers in small space and our salesmen overlooked no opportunity to talk about it to both men and women. As a result, we now have sixty ranges already installed and in service, and we have orders for twelve more for spring delivery. One salesman alone took orders for twenty ranges in a period of nine and a half days, which shows how well our liberal offer took hold.

We also believe that it is easier to sell ranges where the customers agree to pay $4 installation charge in case they do not keep the range. They do not feel then that they are under any obligation to us if they send it back at the end of the trial period and pay the penalty in case the range does not suit them. This makes them have more disposition to try out the range, and the plan

undoubtedly won us a great part of our business. Nevertheless, every range that was put out on trial was sold within the thirty days. Not a single one came back.

OTHER HEATING BUSINESS

We have never tried to sell electric water heaters, for the reason that we are not able to make a rate low enough to make their use practicable, inasmuch as our energy is generated by steam. But we try to get all of our range customers to install a small combination laundry stove and water heater, for if a housekeeper attempts to heat water for dish-washing and all other purposes on an electric range at a 4-cent rate, she will find her bills will run pretty high. We have induced our customers to buy ranges of sufficient size, however, to care for their needs, and in one or two cases we have sold full-size ranges where our customers thought they wanted a two-burner hot plate, for we have in all cases wanted the customer to have a stove that would in every way fill requirements; and now nearly every one of our customers is a booster.

We have six restaurants also using electricity for making coffee. We have supplied them with 880-watt elements mounted on home-made legs and having a three-heat switch, and the average revenue per month from these coffee heaters is $13.17, the connected load in each case being only 880 watts. The heating elements are run at "medium heat" nearly all the time, although occasionally they are turned on "high" for short periods. These coffee heaters were made for gasoline burners, and we simply removed the gasoline burner and replaced it with the electric heating element.

It has been very surprising to us to note the influence of this heating business on our peak, for while we expected it to bring a noticeable increase, as a matter of fact, it has been small—not over 25 kw. We expect to reduce our cooking rate to 3 cents and hope to have at least 150 ranges in use before Jan. 1, 1917.

Making the Electric-Lighted Signboard Attractive

Although the average central station has given small attention to the development of the illuminated signboard, the experience of the Omaha (Neb.) Electric Light & Power Company has shown how productive this type of business may be made. Last year this signboard load in Omaha brought in a revenue of over $6,500. The success which the local company has had in the development of this opportunity is attributed in large part to the fact that constant effort has been made to furnish original ideas for the displays which will make them a less objectionable feature of the landscape and of greater value to the advertiser. How this idea is applied is well illustrated in the accompanying picture. In this case a section of the board is painted to represent an open gate, with a walk in the background and the doorway of a house. This board is lighted with 100-watt Mazda lamps set in reflectors which extend out one-half the height of the board. Ornamental red globes, which are illuminated, are mounted on top of the brick columns between the sections of the board.

AN ATTRACTIVE SIGNBOARD AT OMAHA, NEB.

Income from Flatirons in the Garment Trade

Some interesting figures in connection with heating installations for industrial uses have recently been collected by the heating bureau of the New York Edison Company, embracing a study of eight flatiron installations served by the company. These eight installations totaled 105 irons, which consumed 67,659 kw.-hr. for the past year, representing an average yearly consumption of 644 kw.-hr. per iron, or an income, at an 8-cent rate, of $51.52 an iron per year.

The first case was a cloak and suit manufacturer with an equipment of twenty Simplex irons of the 770-watt type. By actual meter readings this installation for 1915 brought in a return (at a 5-cent rate) of $1,113.15 to the company. Case No. 2 was a fashionable men's tailoring establishment on Fifth Avenue. Here thirteen General Electric flatirons produced $402.75. A "waist house" using eighteen 6-lb. Reimers irons was tested, this being a type consuming only half as much energy as the irons used by the tailor. The company's annual income here was $486.36. Another "shirtwaist house" using twenty-four of these lighter irons consumed $750.72 worth of electricity. As New York is the center of the garment trade for the United States, this class of business offers an extensive and lucrative field.

A "Smoker" for Power Customers and "Prospects"

A most successful method of interesting and instructing present and prospective power customers in the design, application and operation of alternating-current motors was introduced recently by Thomas Donahue, manager of the Indiana Lighting Company, Lafayette, Ind. Invitations were sent to all power customers and to others interested in induction motors to attend an evening "smoker" at the offices of the company, and seats for 100 guests were arranged in a portion of the salesroom of the new office building, a stereopticon and screen being installed for the use of the lecturers.

Through J. B. Crankshaw, manager of the Fort Wayne works of the General Electric Company, J. P. Catlin of the Pittsfield works, and H. C. Hill of the Lynn works were secured as speakers for the evening. Mr. Hill gave a very interesting illustrated address on the design, application and operation of polyphase induction motors, and was followed by Mr. Catlin, who gave an illustrated talk on single-phase and variable-speed induction motors. Several motors on exhibition were disassembled by the speakers in order that the guests might properly understand the details of design and operation.

Instead of the usual method of asking for open discussion on the various points brought out, each guest was requested to write question on blank paper pro-

vided for this purpose. Immediately following the talks these questions were answered. Some very interesting discussions resulted from the questions and answers. The large number of pertinent questions, both practical and theoretical, presented in this manner seemed to indicate that those present were much interested in the evening's program. Mr. Donahue is enthusiastic over the results of this meeting, and is contemplating similar meetings covering other lines of electrical devices of interest to his customers.

Electrical Safety Lessons from the Fire Chief's Report

Taking the annual report of Chief Shepard of the Pittsfield (Mass.) fire department, the Pittsfield Electric Company analyzed the figures therein presented and made the results the basis of an advertisement to demonstrate the comparative safety of electricity.

Of the 197 fires reported, thirty-eight, or 19 per cent, were from causes which the use of electricity might

Here's the Proof!
CAUSES OF FIRES
ANALYZE CHIEF SHEPARD'S REPORT
Fires that could be prevented if ELECTRICITY were used
Fires Caused by Careless Use of Electrical Appliances
ELECTRIC FLATIRON 1
ELECTRIC MOTOR 1
TOTAL . . . 2
TOTAL NUMBER OF FIRES 197
1 % were caused by Electricity
Wire Your House for Electric Service and Be Nineteen (19) Times Safer from Fire.
Save Your City, $18,658—"Safety First"
Pittsfield Electric Co.
PHONE 947

THE FIRE CHIEF'S REPORT ANALYZED

have avoided. Among the causes for fires thus classified in the company's half-page advertisement, which appeared in the Pittsfield papers, were the following:

Explosion of oil can	1
Stepping on parlor match	1
Children with matches	11
Oil stove	1
Kerosene-oil lamp	2
Kerosene-oil lamp exploded	1
Rats and matches	2
Lamp in clothes press	1
Child overturning lamp	2
Careless use of matches	13
Gas jet	1
Children with lighted candle	1
Wind tipping house, overturning lamp	1
Total	38

A "Brighter Brooklyn" Ornamental Lamp-Post Installed for $47.50

To Brooklyn merchants who install during the twenty-nine days of February one of the ornamental curb standards offered by the Edison Electric Illuminating Company the company tenders a special price of $47.50 for the standard complete and erected, this amount being payable $7.50 down and $10 a month for four months. The sale price includes the post connected and in place, five 100-watt lamps, globes, etc. These posts are lighted nightly from dusk to midnight for $6.50 per month, including lamp renewals—which, as pointed out in effective advertising, is only 22 cents a day.

Encouraging the Customer to Read His Own Meter—Monthly and Daily

That the customer may be advised beforehand when his consumption of kilowatt-hours for a given month has been unusually large, and that meter errors may be detected promptly, the South Manchester (Conn.) Light, Power & Tramway Company is encouraging its customers to make monthly—if not daily—scrutinies of their meter dials.

In January the company inclosed with the bills mailed out a booklet on how to read the meter and the proper methods of using electric service. With the bills mailed Feb. 1 was inclosed a statement from the company asking the co-operation of the consumer in assisting to detect any error that might be made. This, the statement suggests, can be done by being present when the meter is read. "It is only necessary to give a few minutes of your time each month to take the reading and check of reader. We would prefer, in fact, that you read the meter daily, as it would inevitably prevent long-standing disordered meters and keep you within bounds as to daily consumption," the statement made to the customer goes on to say.

Lighting the Exterior of Buildings

At a meeting of the Chicago Section of the Illuminating Engineering Society J. R. Cravath of that city addressed the members on "Lighting Building Exteriors." After sketching the development of exterior building illumination in its progress toward modern flood-lighting, the speaker named the following advantages which flood-lighting has over other systems: Novelty, smaller expense, freedom from glare, greater dignity, the possibility of securing striking effects at reasonable cost, the possibility of color applications, and the fact that it really shows the building.

In speaking of the efficiency of projector units for flood-lighting, Mr. Cravath pointed out that to be efficient a unit must carry the lamp filament well toward the back of the reflector. If the lamp filament lies near the mouth of the reflector, a great portion of the light

DATA ON COMBINATION LIGHTING OF THE EXTERIOR OF THE EDISON BUILDING, CHICAGO

Location	Type of Lamps	Number of Lamps	Size of Lamps in Watts	Load in Kw.	Spacing of Lamps on Centers
Roof	Type C	193	100	19.3	1 ft.
Sixteenth floor	Vacuum tungsten	740	25	18.5	6 in.
Fifteenth floor	Vacuum tungsten	740	25	18.5	6 in.
At top of ledge, fourth floor	Type C, in projector	125	250	31.1	3 ft.
Below ledge, fourth floor	Vacuum tungsten	1110	15	16.7	4 in.
At top of ledge, second floor	Type C, in projector	54	250	13.7	7 ft.
Below ledge, second floor	Vacuum tungsten	560	40	22.4	8 in.
Totals		3522		140.0	

flux escapes without being intercepted by the reflecting surface and is not directed at the object to be lighted. Installations of flood-lighting mentioned by the speaker varied widely in energy expenditure per unit of surface lighted. Of those mentioned, the top of the Woolworth Building, with 4 watts per square foot, used the highest unit wattage, while in other installations the unit expenditure did not exceed the low figure of 0.45 watt per square foot.

Two objections to flood-lighting as a method of illuminating building exteriors were raised in the discus-

sion. One of these was that it renders night work in some rooms of the lighted building impossible without drawing the shades. Another was that suitable long-time leaseholds for projector locations on adjacent buildings are expensive and hard to obtain. The opinion that these two objections are important was, however, not unanimous. Some of the unusual and new applications of flood-lighting mentioned were: Ice-harvesting fields, statues and monuments, guarded territory around powder mills, prison walls, oil-well outfits, building under forced construction, trap-shooting grounds, municipal playgrounds and public swimming beaches.

J. B. Jackson of the Commonwealth Edison Company during the discussion told of the plans that have been developed for lighting the exterior of the Edison Building. A combination of outline lighting and flood-lighting will be used. Data on the installation as given by Mr. Jackson are presented in the table on the opposite page.

The selection of this combination of types of lighting was made after months of experimental work. Much of the apparatus used will be of special design. To keep the maintenance charges low and to produce effective and pleasing illumination were the thoughts uppermost in the minds of the designers of the system.

New Rates for Residence Service to Encourage Electric Cooking at Minneapolis

The Minneapolis General Electric Company, Minneapolis, Minn., has announced a new schedule of residence rates, effective March 1, which differs from the old rates by a reduction of the initial charges for energy and the addition of another step in the schedule of energy charges, as follows:

PRESENT SCHEDULE

	Per Kw.-hr.
First 3 kw.-hr. per room per month	9 cents
All excess	6 cents

Cash discount, 5 per cent.

NEW SCHEDULE

First 3 kw.-hr. per room per month	8½ cents
Next 3 kw.-hr. per room per month	6 cents
All excess	2½ cents

Cash discount, 5 per cent. Minimum bill to remain as at present—$1 per month, less 5 per cent.

The introduction of this new rate is expected to encourage cooking by electricity, and by providing such service at a cost which will be capable of competition with gas, to offer a stimulus to the sale of electric ranges in which the company is about to engage. A large second-story room in a building adjacent to the electric company's building and communicating with it has been engaged and will be utilized for the display and demonstration of a number of types of electric ranges. Extensive advertising will be done and a general campaign carried on to place a large number of electric ranges on the company's lines.

Assisting the Church to Wire

The Dayton (Ohio) Power & Lighting Company has made many friends and won considerable business by assisting in the installation of electricity in the local churches. When the lines of this company enter a new territory it has been the policy to contribute $50 or $75 toward the wiring of the principal church, whose members and trustees are naturally residents in the community. Invariably this generous gift is gratefully accepted, and the novelty of the installation becomes an immediate and conspicuous advertisement for the electric company. Moreover, the trustees are usually prominent business men and men much more likely to give time and thought to the consideration of the advantages of electric light in their capacity as trustees for the church than at the solicitation of a salesman who may call at their offices on busy days or at their homes in the evening.

Such a gift to the church has always established the company most favorably in the eyes of the community, and so widely has the news spread that in several cases representatives of other churches have come to the company requesting similar donations to assist them in wiring their buildings, and these have always been granted.

Motion-Picture Arc Operated from Vehicle Batteries in Emergency

BY FRANK C. TAYLOR

When a travel-lecture with motion-pictures was to be presented at the New York State armory in Rochester, N. Y., early this month, it was found that only alternating current was available for the motion-picture machine. Because of the well-known fact that direct current produces a better arc than alternating current, it was desired that direct current be supplied to the machine, although the distance of the nearest direct-current mains from the armory was so great as to prohibit the supply of direct current from the Edison system.

An electric truck from the Rochester Railway & Light Company offered, however, an easy solution of the problem. The truck was driven into the basement of the building and wires were quickly run connecting the battery with the arc of the moving-picture machine. The truck was equipped with a forty-four-cell, MV-19 plate "Ironclad" battery with a rating of 298 amp.-hr., and this battery proved to have sufficient energy to operate the moving-picture machine for more than six hours.

"What One Cent's Worth of Electricity Will Do"

The Merchants' Heat & Light Company of Indianapolis, Ind., has been attracting the attention of its local public to the economy of the use of domestic electric appliances by its display of the "1-cent" card shown herewith, setting forth what 1 cent's worth of electricity will do. According to R. A. MacGregor, sales manager of the company, the figures on the card are based on a rate of 5 cents per kilowatt-hour, the equivalent rate secured by the company's residence customers.

A Cent's Worth of Our Service

WILL

Toast 30 slices of bread
Brew 14 cups of tea
Make 14 cups of coffee
Boil 30 eggs
Warm 6 bottles of baby's milk
Light a 40-watt lamp 5 hours
Operate a flatiron for 25 minutes
Operate a vacuum cleaner 1½ hours
Sew 60,000 stitches on a machine
Operate a warming pad 2 hours

And Always Meet You With a Smile

Associated Charities Hold Benefit Sale of Electric Appliances in Colorado Springs Electric Shop

The second special charity sale of appliances has just been held in the salesroom of the Colorado Springs (Col.) Light & Power Company under the auspices of the local Associated Charities. Following the plan of last year, representatives of the charities body were put in charge of the display room to sell electric and gas appliances, on which a liberal commission was paid to the charity funds. The electric-appliance sales for the day amounted to $599, of which the Associated Charities received commissions amounting to $189. The company ran special newspaper advertisements preceding the event, and both its building and display room were elaborately decorated at the time of the sale.

Temperatures of Gas-Filled Tungsten Lamps

S. E. Doane, chief engineer for the National Lamp Works of the General Electric Company, Nela Park, Cleveland, Ohio, speaking before the Western Association of Electrical Inspectors, said that the measurement of the temperature of gas-filled lamps is attended by many difficulties on account of the fact that the light rays are intercepted by the thermometer used and upon their interception are transformed into heat. Careful tests which have been made in the Nela Park laboratories, however, seem to indicate that the maximum temperature obtained by gas-filled lamps is 150 deg. Fahr. Mr. Doane declared it to be his belief that the lamps themselves, as far as temperature is concerned, are safe enough. It is true, however, he said, that the bases of gas-filled lamps do become hotter than the bases of the former tungsten lamps, but in general it has been found that sockets and the wire in them are not affected by the temperature produced by the lamps. Contrary to expectations, it has been found that rubber-covered wire withstands the temperatures produced by the lamps better than any other wire yet investigated.

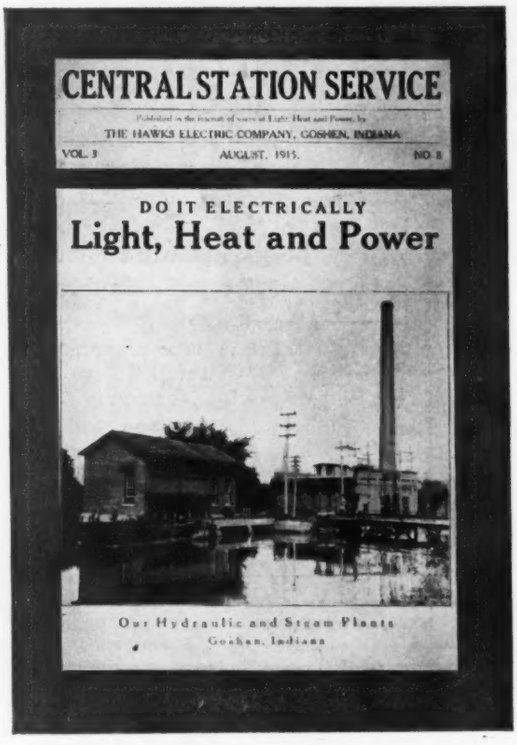
Electric Industrial Trucks in Municipal Dock Service at Portland, Ore.

One of the large municipal docks at Portland, Ore., makes daily use of two 4000-lb. electric industrial trucks in loading and unloading vessels and in transferring freight from one end of the dock to the other. According to the superintendent in charge of the installation, comparative tests have shown that with the old hand trucks one man could make a trip every five minutes with two crates of cans and was able to load twenty-four crates per hour. The electric truck, on the other hand, makes the same trip every two and one-half minutes, carrying eight crates of cans at a load, and on tests has loaded 192 crates per hour, meanwhile requiring the services of only one man on the truck.

For loading salt, which is handled in 340-lb. sacks, a 3-ton gasoline truck was formerly used. Each trip consumed fifteen minutes, and as the truck carried twenty-six sacks to a load, it was able to deliver 35,360 lb. of salt per hour. Two men were employed with this gasoline truck. The electric truck makes the same trip in seven and one-half minutes, carrying fourteen sacks of salt per trip, and in one hour delivers 38,080 lb. of salt, requiring, moreover, the services of only one man on the truck. It costs 57 cents per hour to operate the electric truck, as compared with $1 per hour for the gasoline truck. The electric truck recently handled 1770 cases of salmon in three hours with four men loading and unloading. Had hand trucks been used, it is estimated that twelve men would have been required, working nine hours, to do the same work.

A Central-Station Bulletin in a City of 10,000 People

Although many of the larger central-station companies have their bulletins or house organs which are distributed monthly or at other intervals among their customers, it is quite extraordinary to find such a publication published and circulated by a utility company operating in a city of only 10,000 population. To tell its story of electric service to the local public, the Hawks


CENTRAL STATION SERVICE
THE HAWKS ELECTRIC COMPANY, GOSHEN, INDIANA
VOL. 3 AUGUST, 1915. NO. 8
DO IT ELECTRICALLY
Light, Heat and Power
Our Hydraulic and Steam Plants
Goshen, Indiana

COVER OF CENTRAL-STATION BULLETIN ISSUED BY COMPANY AT GOSHEN, IND.

Electric Company of Goshen, Ind., about a year ago determined to issue a periodical bulletin, and the first number of this illustrated twenty-page booklet was mailed to a selected list of about 1500, including the company's customers and other citizens who were thought to be good "prospects," needing only to be better informed about electricity and the company's service.

More than a dozen numbers have now been issued, and the mailing list at present numbers 2300 names. Moreover, each month persons come into the office and ask to be placed on the list for "Central-Station Service," as the little publication is called. The text matter of the booklet includes useful information concerning the application and use of electrical apparatus of particular interest to different classes of patrons. Owen C. Cover, manager of the company, estimates that the new business directly traceable to the publication has been sufficient to meet the expense of issuing it. The present edition of 2500 copies costs about 4 cents per copy to print and deliver.

ADVANCE IN TECHNICAL THEORY AND PRACTICE

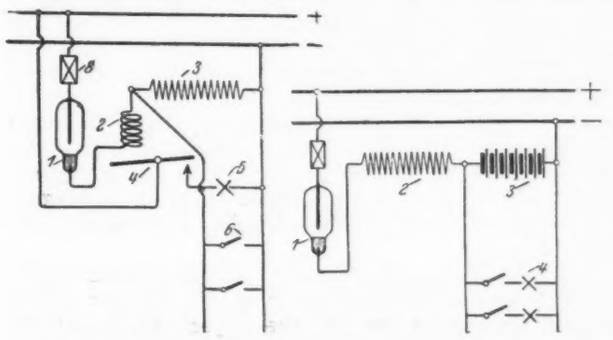
Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Neon-Helium Tubes as Rectifiers and Voltage Reducers

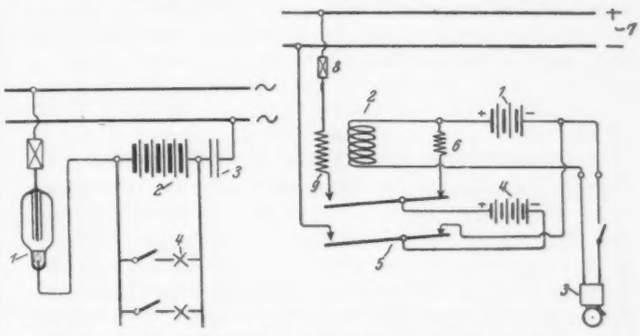
Operation of Bell and Signal Systems from Lighting and Power Circuits—Use of Tubes as Telephone Lightning Arresters—The "Double Battery" System

IN these columns the remark was made several weeks ago that when an advance occurs in technical chemistry it is quite impossible to predict how many other industrial fields will be thereby affected. We may now cite liquefaction of air as another example. Liquefaction of air, with subsequent fractional evaporation, has yielded commercial oxygen for oxy-acetylene welding and cutting, and also nitrogen for calcium-cyanamide manufacture. But it has also rendered commercially available the so-called rare gases of the atmosphere—argon, neon and helium. These have found application not only in the Moore-tube lamp but in the gas-filled tungsten incandescent lamp. And now comes from Germany an account of neon-helium tubes used as telephone lightning arresters and as voltage reducers to operate bell and signal systems from lighting and power circuits. Notes on this subject were already given in the Digest in the ELECTRICAL WORLD of March 27, 1915, and Feb. 5, 1916. Herewith we reproduce, however, from an article by Dr. Fritz Schroeter in the *Elektrotechnische Zeitschrift* for Dec. 23 and 30, 1915, a description of the way in which these tubes are to be used as voltage reducers. It will be remembered that these are simply Geissler tubes with a sodium or potassium amalgam cathode and an iron anode with an atmosphere of a mixture of neon and helium. When a current of a few milliamperes passes, such a tube consumes about 190 volts. Hence if such a tube is connected in series with a proper resistance across a 220-volt lighting or power circuit, the voltage available at the ends of the series resistance is 30 volts, and to these ends a bell circuit or other signal circuit may be connected.

Fig. 1 shows the arrangement which makes it possible to light a signal lamp 5 or some other device from different switching places. The energy of the lighting (or power) current is utilized for the operation, while the conductors to the different switching points are made according to the regulations for bell, signal, etc., circuits. The helium-neon tube 1, in series with a high-resistance relay 2 and a resistor 3, is connected across the two conductors of the lighting circuit. A very small current passes through the helium-neon tube without causing the relay to act. An important feature of the helium-neon tube is the fact that it is not changed by the continuous passage of this small current. The signal line is connected to the terminals of the resistor 3, and 6 is one of the switches which puts



FIGS. 1 AND 2—TWO ARRANGEMENTS OF NEON-HELIUM TUBES TO ACT AS VOLTAGE REDUCERS



FIGS. 3 AND 4—OTHER ARRANGEMENTS OF NEON-HELIUM TUBES TO ACT AS VOLTAGE REDUCERS

the signal system into operation. When switch 6 is closed the resistor 3 is short-circuited, whereby the current in the winding of relay 2 is sufficiently strengthened to attract the armature 4; the signal lamp 5 then lights up. Switching points 6 may be arranged in any number and at any distance, and the wiring connections may be made according to the rules for ordinary bell and signal circuits. In a general way, it is possible to use the helium-neon tubes for any arrangement in which for the operation of a signal circuit it is desired to take currents up to 2 amp. (and temporarily up to 3 amp. or 4 amp.) from a lighting circuit.

Storage batteries have been found to be very well suited for the operation of signal and similar circuits. A battery 3 in series with a high resistance 2 is connected across the lighting circuit, and the two wires of the signal circuit are connected to the terminals of the battery 3, as shown in Fig. 2. The continuous current of a few milliamperes passing through the battery keeps it fully charged and is too small to overcharge it. Such arrangements are in use, for instance, for railway signals. The danger exists, however, that in case of contact faults in the battery a high voltage may occur in the signal circuit. This is avoided if, as shown in Fig. 2, a neon-helium tube 1 is connected in series with the resistor 2.

It is rather interesting to note that the same arrangement may be used to keep a battery constantly charged from an alternating-current network, as shown in Fig. 3. The neon-helium tube 1 acts in this case as rectifier. For such purposes the anode is preferably surrounded by an insulating tube. The rectifying efficiency is 40 per cent, which is sufficient, since efficiency is far less important in such cases than ease and simplicity. Three is a protective condenser.

Finally a system is described in which the signal circuit is supplied with current from a storage battery and the latter is kept fully charged from a second battery (hence the name "double-battery system") in such a way that the first battery is never exhausted. In

Fig. 4 the bell 3 is supplied with current from the storage battery 1. The same circuit contains a relay 2 which operates a switch 5 with two pairs of contacts. Fig. 4 shows the system at rest. When the bell 3 is operated, the relay 2 is excited and the auxiliary battery 4 is disconnected from the signal circuit. Contact is simultaneously made at the contact points at the left hand of the illustration so that a certain current (the intensity of which is determined by the resistance 9) passes from the lighting circuit into the auxiliary battery 4. When the current from battery 1 for operating the bell 3 stops, the relay armature drops and connection is now made of battery 4 with battery 1. The former now charges the latter. Battery 1 always will be fully charged, while an overcharge is prevented because the number of cells of 4 is greater than that of 1. Several other arrangements of the double-battery system are also described. All these arrangements appear to have been tried for a couple of years but still await introduction on a large scale.

Generators, Motors and Transformers

Eddy-Current Loss in Dynamo Teeth.—F. W. Carter.—An illustrated article on a simple rule for the calculation of the eddy-current loss in dynamo teeth. The rule is that the eddy-current loss calculated in the ordinary manner—that is, on the assumption that the magnetization varies with the time according to a sine law—should be multiplied by the ratio of the pole pitch to the interpolar space, or divided by 1 minus the ratio of pole arc to pole pitch; since the multiplier is of the order of three or four, its effect is to reduce appreciably the gap separating accountable from actual iron losses. While this rule is a convenient approximation for the ordinary use of the designer, the author also develops a formula for use in anomalous cases.—London *Electrician*, Jan. 21, 1916.

Performance of Dynamo-Electric Machinery.—Miles Walker.—The conclusion of his paper on the predetermination of the performance of dynamo-electric machinery. Several appendixes are given dealing with the calculation of the magnetizing current, the armature reaction, the loss in copper and iron, and the predetermination of the temperature rise. A rather full account is given of the discussion which followed the presentation of the paper in London and Birmingham.—London *Electrician*, Jan. 21, 1916.

Traction

Electric Railways.—H. M. Hobart.—The conclusion of his James Forrest lecture before the (British) Institution of Civil Engineers. In the present installment the author deals with regenerative braking on the Chicago, Milwaukee & St. Paul Railway and then describes the electrification of the Bluefield division of the Norfolk & Western Railway. The author then discusses the relative extent in the United States of single-phase and high-pressure direct-current electrification. His table shows that the high-pressure direct-current system has made greater progress in recent years. But it should not be concluded that there is no longer any activity in America in applying the single-phase system to railways. For tramways and light railways single-phase apparatus is generally admitted to be inferior, and no new undertakings have adopted the single-phase system for several years. But extensive single-phase applications have been made in the electrification of sections of main-line railways. Notable among these are the Norfolk & Western Railway, the New York, New Haven & Hartford Railroad and the Pennsylvania Railroad. The author is satisfied that the high-pressure direct-current system is so distinctly superior in essential respects as ultimately to insure its general use on main-line railways in preference to the single-phase system or any of its modifications. The author quotes opposite opinions by B. G. Lamme and W. S. Murray. As to the relative merits of single-phase and direct-current locomotives, the author concludes that, owing to the lower "drivers-to-drawbar" efficiency and the lower efficiency of the electrical equipment of single-phase locomotives, a given output from the drawbar will (taking into consideration all the varieties of traffic on the railway) require so much greater consumption of electricity by the locomotives as to offset fully any economies in substations and distribution system. This conclusion concerning the relative consumption of the two types simply refers to one of the items entering into a comprehensive comparison. Among other matters requiring consideration are the relative initial costs of locomotives of equal capabilities of the two types, the relative outlays for repairs, and the relative reliability. In the concluding chapter the author deals with the cost of electricity as delivered at the locomotive with direct-current and single-phase systems. The conclusions of the paper are to the effect that, first, we are on the eve of the extensive employment of electric locomotives on railroads at present operated with steam locomotives; second, that the direct-current system is the most appropriate and, third, that direct-current locomotives for use from high-pressure contact conductors are now a thoroughly demonstrated success.—London *Electrician*, Jan. 14, 1916.

Installations, Systems and Appliances

Johannesburg.—The first part of an illustrated article on the municipal electricity supply of Johannesburg. The plant has recovered from its former troubles with old-fashioned steam plant and unreliable gas engines. The principal power plant now contains ten generators of an aggregate rating of 13,500 kw. The three largest sets, each of 3000 kw., are turbo-alternators. The smaller sets are reciprocating machines. The station also contains some 4000 kw. of motor-generator plant for converting alternating current to direct current. There are three distinct systems of supply for the generating station. The central parts of Johannesburg are supplied, both for lighting and power, by a three-wire direct-current system at 230 volts and 460 volts. The outlying suburbs are fed by single and two-phase feeders (the latter for power) at 3000 volts to step-down transformers, from which the supply is taken at 200 volts for domestic and street lighting. There is also a third supply at 600 volts, direct current, for traction purposes.—London *Elec. Review*, Jan. 21, 1916.

New British Electric Companies.—A list of the more important electric engineering companies registered during 1915 in Great Britain, with their capital. Ninety-six companies are listed, with an aggregate capitalization of $8,770,000.—London *Electrician*, Jan. 7, 1916.

Electric Water Heaters.—A. Rittershausen.—An English translation in abstract of his German paper, noticed some time ago in the Digest, analyzing the losses from electrical water heaters.—London *Electrician*, Jan. 28, 1916.

Wires, Wiring and Conduits

Crossing a River.—C. Bohnenberger.—An illustrated article on the methods employed on the crossing of a transmission line over the Dievenow between Hagen and Wollin in Germany. Steel poles in concrete foundations are used. The calculation of the pole design is given.—*Elek. Zeit.*, Dec. 9, 1916.

Electrophysics and Magnetism

Magnetic Transformation of Iron.—KOTARO HONDA AND HIROMU TAKAGI.—An account of an experimental investigation of the magnetic transformation of cementite. The authors found that on cooling the magnetic transformation of cementite begins at 220 deg. C., and on heating it ends at the same temperature. This is the critical temperature of the cementite. As in the case of iron or other ferro-magnetics, the transformation takes place gradually, at least in a range from 50 deg. to 60 deg. C. A note is added on a magnetic study of the A-3 transformation in pure iron.—London *Eng'ing*, Dec. 31, 1915.

Units, Measurements and Instruments

Measuring Small Capacities.—WILL C. BAKER.—A description of a method which permits capacities as small as 1 cm. or 2 cm. to be evaluated by comparison with the capacity of a parallel-plate condenser of variable plate distance. Let C be the small system, of capacity x, to be measured, one of its "plates" being grounded. Let K_1 be the capacity of the parallel-plate condenser when its plates (A and B) are d_1 cm. apart, A being at potential, V and B being grounded. First A and C are connected, then the connection is broken, C is discharged, and then the connection is again made. This operation is repeated n times. The plates A and B are then drawn apart until the potential of A returns to V. If the new plate distance is d_2 and the corresponding capacity K_2, the author shows that

$$K_1 + x = K_1(d_2/d_1)^{1/n}.$$

A series of determinations may be made as follows: Start from K_1 as the initial capacity, make, say, twenty contacts with C as described, and restore the potential by lowering the capacity to K_2. Now, with K_2 as the initial capacity, make twenty more contacts and obtain a second value for x by restoring the potential in changing the capacity to K_3. With K_3 as the initial capacity, obtain a third value for x, etc. Working in this way we obtain a series of determinations in which any error, either in setting the plates to restore potential (i.e., in the reading of the electroscope) or in the reading of the plate distance (d) in a given observation, causes an equal and opposite error in the next succeeding observation. Thus the mean of such a series should be of a higher accuracy than the mean of an equal number of disconnected observations. The application of the method is described.—*Phys. Review*, January, 1916.

Producing High Permeability in Iron.—ERNEST WILSON.—A brief illustrated paper on the changes of permeability of a 3 per cent silicon alloy of iron over a range of the magnetic induction B from about 0.5 to 100. It is shown that if a ring consisting of laminas of the material is placed within a special magnetic shield and then subjected to a process of careful demagnetization, the permeability can be largely increased.—London *Electrician*, Jan. 28, 1916.

Telegraphy, Telephony and Signals

Principles of Modern Printing Telegraphy.—H. H. HARRISON.—The first part of an illustrated paper read before the (British) Institution of Electrical Engineers. This paper is divided into five sections. The first deals with the fundamental principles and leads up to automatic stop and start. After that follow translation of signals, page printing, and the principles of letter-counting mechanism. The third section deals with low-speed printing telegraphs and chain-relay systems. The fourth discusses synchronism and control of phase, leading to synchronism between printer and distributer units. The last part deals with automatic multiple-circuit arrangements, echelon working, repeaters, distribution of signals and quadruple duplex.—London *Electrician*, Jan. 28, 1916.

Miscellaneous

Electric Welding.—The first part of an illustrated serial giving notes on electric-welding practice. After introductory notes on the applicability of the electric-welding process and the strength of the electric weld, the author takes up the discussion of methods, beginning with arc-welding methods. The article is to be continued.—London *Elec. Review*, Jan. 21, 1916.

Book Reviews

BEITRAG ZUR BERECHNUNG VON MASTFUNDAMENTEN. By Dr. Ing. H. Fröhlich. 60 pages, 61 illus. Berlin, 1915: Ernst & Sohn. Price, paper, 2.60 marks.

A very practical mathematical investigation of the formulas ordinarily employed in German textbooks on the strength of tower foundations for the support of overhead-line conductors. Tests were made of a series of steel lattice towers with bases of different sizes and forms. Horizontal deflecting forces were applied to these towers, and the ensuing deformations were observed. As the result of the tests and of their analyses the author points out improvements which appear to be indicated for embodiment in the formulas for dealing with the design of such towers. The records of the tests and the computations based thereon make a valuable contribution to the literature of the subject.

DIE FUNKENTELEGRAPHIE. By H. Thurn. Leipzig and Berlin: B. G. Teubner. 112 pages, 51 illus. Price, 1.25 marks.

A very practical little treatise on radiotelegraphy from the German point of view, now appearing in its third edition. It is descriptive and not mathematical in its treatment. There are nine chapters devoted to the following topics: Fundamental principles, historical outline, constructive details, principal sending and receiving systems, different types of stations, principles of radiotelephony, examples of telephonic systems, influence of radio communication on cable telegraphy, and radiotelegraphy in commercial marine service. The book occupies a middle ground between a popular treatise and a technical textbook. It is devoid of algebra.

Books Received

Mechanical Drafting. By Charles B. Howe. New York: John Wiley & Sons, Inc. 148 pages, 166 illus. Price, $1.75.

The Elements of Mechanics of Materials. By C. E. Houghton. New York: D. Van Nostrand Company. 216 pages, 94 illus. Price, $2.

Annuaire pour l'An 1916. Published by the Bureau of Longitudes. Paris: Gauthier-Villars & Co. 900 pages, illustrated. Price, 1.50 francs.

Pole and Tower Lines for Electric Power Transmission. By R. D. Coombs. New York: McGraw-Hill Book Company, Inc. 272 pages, 163 illus. Price, $2.50.

An Elementary Manual of Radiotelegraphy and Radiotelephony for Students and Operators. By J. A. Fleming. New York: Longmans, Green & Company. 360 pages, illustrated. Price, $2.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

G. J. BALDWIN

George J. Baldwin, president of the Savannah (Ga.) Electric Company, and other utilities operated by the Stone & Webster interests, has been elected vice-president of the American International Corporation, recently formed to extend the foreign financial and commercial relations of the United States. Mr. Baldwin plans in the future to spend most of his time in New York City, but will not relinquish his connections in the South as president of the Savannah Electric Company, the Jacksonville Traction Company, the Key West Electric Company, the Pensacola Electric Company and the Tampa Electric Company. It is stated that Mr. Baldwin will have immediate direction of the investigations that will precede affiliations and investments by the American International Corporation. Charles A. Stone, of Stone & Webster, is president of the American International Corporation.

E. W. Rising, who for the last two years has been connected with the Great Shoshone & Twin Falls Water Power Company of Twin Falls, Idaho, has been appointed secretary, treasurer and general manager of the Hailey Electric Company of Hailey, Idaho, succeeding John R. Hart, resigned.

G. Wilbur Hubley, former chief engineer of the old Louisville Lighting Company, Louisville, Ky., has just been appointed an honorary member of the Engineers and Architects' Club of Louisville in appreciation of his work in building up the organization at the time he served as its president. Mr. Hubley is now connected with the electrical department of the Jones & Laughlin Steel Company of Pittsburgh, and makes his residence at the Franklin Hotel, Woodlawn, Pa.

W. S. Long has been appointed treasury representative of the Westinghouse Electric & Manufacturing Company in its Chicago office, effective Feb. 1. Mr. Long has been in the treasury department at Pittsburgh for about eleven years. Maintaining a division of the treasury department at branch offices is a part of the new organization scheme of the Westinghouse company and is designed to facilitate the work of the credit and collection departments and generally to improve the business routine.

Corneil Ridderhof, who was until recently advertising manager for Electrical Prosperity Week on the staff of the Society for Electrical Development, Inc., has been appointed advertising manager of the Coles Picture Machine Corporation, 120 West Forty-first Street, New York City. Prior to April, 1915, Mr. Ridderhof was manager of the advertising department of the Hotpoint Electric Company of Ontario, Cal.

Du Pont Guerry, Jr., who has been appointed a member of the firm of Huntington & Guerry, electrical engineers and mill-plant contractors of Greenville, S. C., is a native of Macon, Ga., and was graduated from the Alabama Polytechnic Institute at Auburn in 1906. After experience in the testing department of the General Electric Company at Schenectady, N. Y., Mr. Guerry entered the office of J. E. Sirrine of Greenville, S. C., a leading mill engineer, with whom he remained eight years as an engineer in the electrical department. For a year Mr. Guerry was also superintendent of construction with the Reedy River Power Company.

CAPT. W. H. G. BULLARD

Capt. William H. G. Bullard, superintendent of the Naval Radio Service in charge of operation of stations, with headquarters at Arlington, Va., has accepted an appointment as vice-president of the National Amateur Wireless Association, the members of which are planning courses of instruction by which to make themselves of service to the government in event of war. Captain Bullard has invited amateur operators to write him expressing their willingness to serve the country in case of need. Captain Bullard is a director of the Institute of Radio Engineers, and recently presided as judge of the naval inquiry board which investigated the causes of the explosion on board the submarine E-2 in the New York navy yard.

F. W. SMITH

Frank W. Smith, who as second vice-president of the United Electric Light & Power Company, New York City, has for a number of years been the active managing executive of the organization, has just been appointed general manager of the company through the action of its board of directors. Mr. Smith is one of the early central-station men, having been continuously connected with the United company and its predecessors since 1880, a period of thirty-six years. Mr. Smith first became identified with the old United States Illuminating Company as office boy. Mr. Smith is a past-president of the Electric Vehicle Association of America, and for some years he has been chairman of the lamp committee of the National Electric Light Association.

James D. Andrew, superintendent of the station engineering department of the Edison Electric Illuminating Company of Boston, is now on leave of absence in Chile, where he will make a report on the 40,000-kw. power plant of the Chile Copper Company, the owners of which are considering making a large extension.

Prof. William Lispenard Robb of the Rensselaer Polytechnic Institute, Troy, N. Y., has been retained by Cortland Field Bishop of Lenox, Mass., to make an expert examination of the affairs and property of the Lenox Electric Light Company, as a part of a water-supply development later to be passed upon by the Massachusetts Gas and Electric Light Commission.

Samuel W. Fleming, Jr., of Harrisburg, Pa., who has just been appointed a member of the firm of Farley Gannett, consulting engineers, of that city, is a graduate of Lehigh University, class of 1909. For three years after graduation Mr. Fleming was identified with the Central Hudson Gas & Electric Company of Poughkeepsie, N. Y., as power engineer, and he has recently been engaged in making reports on and investigations of electrical properties in the East and Middle West. In his new connection Mr. Fleming will devote himself to the electrical work of the firm, giving special attention to the design and construction of electrical properties, valuations for rate adjustments, and the operation of electrical systems.

F. H. MOORE

F. H. Moore, the newly elected president of the Western Association of Electrical Inspectors, is a practical man who has risen through the ranks. His early experience in the industry was gained in inside and outside wiring and in telephone work. Since 1904 he has been connected with the Indiana Inspection Bureau at Indianapolis, Ind., and he is now chief electrical inspector of that bureau.

E. W. Hammond, secretary-treasurer of the Avery & Loeb Electric Company, Columbus, Ohio, has been elected president of the Columbus Association of Credit Men.

Irving Bugg has resigned as advertising manager of the Edison Electric Illuminating Company of Brooklyn to join the staff of the Vacuum Oil Company, New York City, as advertising manager.

L. W. Wade, formerly auditor of the Vicksburg (Miss.) Light & Traction Company, has been appointed auditor of the group of electric and gas properties in northwestern Iowa operated by Elston, Clifford & Company, Chicago, with headquarters at Humboldt, Iowa.

W. H. Burke, assistant electrical engineer of the Milwaukee Electric Railway & Light Company, was the guest of honor at a farewell banquet on Feb. 11 tendered by about seventy-five of his associates and friends upon his resignation to become assistant to M. M. Phinney, district manager of the Southwestern interests of Stone & Webster, with headquarters at Boston, Mass. Prior to his becoming connected with the Milwaukee campaign in 1914 Mr. Burke had been in the employ of the Stone & Webster Management Association for about four years, one year of this time having been spent in the general offices in Boston, while for about three years he was assistant to the manager of the Dallas (Tex.) properties of Stone & Webster.

Lane Schofield, who has been appointed manager of the New York office of Harvey Hubbell, Inc., was formerly district manager of the Westinghouse Lamp Company at Cincinnati, and also manager of the detail and supply department of the Westinghouse Electric & Manufacturing Company at Baltimore.

LANE SCHOFIELD

George W. Bacon of the engineering firm of Ford, Bacon & Davis, New York City, has joined the export department of J. P. Morgan & Company. Although retaining his connection with the engineering firm, Mr. Bacon will devote all his time to the Morgan interests, the export department of which is engaged largely in buying supplies for the Allies.

Obituary

J. Rae Wilson, district engineer of the Canadian Westinghouse Company, Ltd., Vancouver, B. C., was killed in the wreck on the Great Northern Railway, Jan. 22, caused by a snowslide near Corea, Wash.

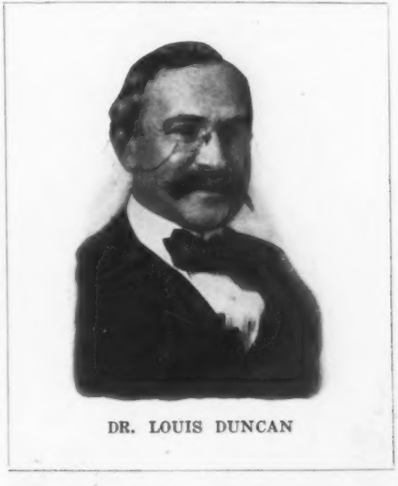
Prof. Nathaniel Craighill, director of the Brooklyn Edison company's school, died suddenly Feb. 7, following a very brief illness. Professor Craighill was in 1904 a member of the staff of the old *American Electrician.*

Frederick Bucherer, a pioneer salesman in the electrical field, died Feb. 7 after a short illness. Mr. Bucherer had been salesman for the Diehl Manufacturing Company, Elizabeth, N. J., for more than twenty-two years.

George Alexander Macbeth, president of the Macbeth-Evans Glass Company, lighting-fixture manufacturer of Pittsburgh, Pa., died at Pittsburgh Feb. 11. Mr. Macbeth had been actively engaged in the manufacture of glassware for fifty years.

Delos A. Chappell of Riverside, Cal., president of the Nevada-California Electric Corporation, died in a hospital at Denver, Col., Feb. 9. Mr. Chappell was sixty-nine years of age. A native of New York, he went West in 1883 and was widely known in Western financial circles. Burial took place at Kalamazoo, Mich.

Dr. Louis Duncan, twice elected president of the American Institute of Electrical Engineers and one of the most brilliant engineers of his generation, died at his home in Pelham Manor, near New York City, Feb. 13, at the age of fifty-four. Graduating from Annapolis in 1880, Dr. Duncan continued in the navy until 1886, taking part meanwhile in special studies and investigations at Johns Hopkins University which led to the determination of the ohm as the international unit of resistance. Later, joining the faculty of Johns Hopkins, he established and took charge of the course of electrical engineering there, continuing in this position fourteen years. Meanwhile, however, Dr. Duncan engaged in much important outside engineering work as a member of the famous consulting firm of Sprague, Duncan & Hutchinson, New York City, his associates being Frank J. Sprague and Cary T. Hutchinson. Among the important installations for which Dr. Duncan acted as consulting engineer were the electrification of the Baltimore tunnels of the Baltimore & Ohio Railroad and the equipment of the Third Avenue system in New York City. Later he was also consulting engineer for the New York City Rapid Transit Commission. In 1899, when the Massachusetts Institute of Technology erected a new electrical laboratory, Dr. Duncan was called upon to inaugurate the new electrical course, and he remained as head of the engineering department until 1904. At the time of his death Dr. Duncan was a member of the firm of Duncan, Young & Company, consulting engineers, New York. He served as president of the A. I. E. E. from 1895 to 1897. During the Spanish-American War he was a major of United States Volunteers. Dr. Duncan's remarkable powers of engineering and mathematical analysis enabled him to reach accurate and brilliant solutions of many intricate problems, and in his later practice as a consulting engineer for a number of large electrical and water-power corporations he directed the expenditure of great sums of money on engineering works. He was an honorary member of the Franklin Institute of Philadelphia and held memberships in the Mathematical Society of France and in the Physical Society of France.



DR. LOUIS DUNCAN

NEW APPARATUS AND APPLIANCES

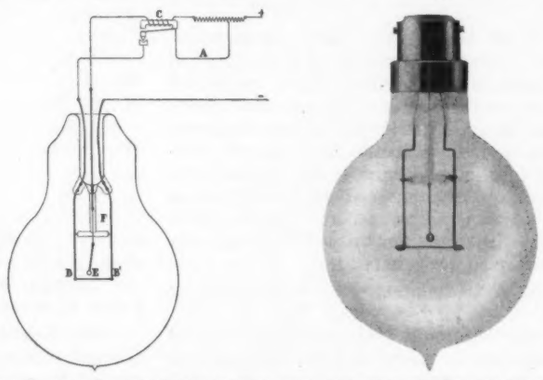
A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Tungsten Arc Lamp for Projector Lanterns

In the ELECTRICAL WORLD of Jan. 1, page 52, there was given an abstract of a communication to the *Journal* of the (British) Institution of Electrical Engineers prepared by E. A. Gimingham and S. R. Mullard describing a new tungsten arc lamp developed by the Edison & Swan United Electric Light Company, Ponders End, Middlesex, England. In this communication it was stated that in 1913 experiments were started in the lamp research laboratory of the above-named company at its Ponders works with the object of making a lamp having the characteristics of the ordinary incandescent lamp—that is to say, as regarded shape and size of bulb, stem and cap—but having as the source of light an arc with electrodes of tungsten or other suitable refractory material burning in an inert gas such as nitrogen or argon. The lamp in the form shown herewith is now being placed on the market for use with projector lanterns and has received the name of "Pointolite" lamp.

The lamp illustrated is designed only for use on direct current. The light-giving part of the lamp is a small ball of tungsten which gives a point of light far exceeding in its intensity, it is claimed, anything hitherto obtained. It can be readily seen that this light source can be very effectively controlled by means of suitable lenses and reflectors, and when used in projection lanterns it produces a perfect disk of light, the manufacturer claims, on the screen, without any blurs or inequalities. The plug on the right of the resistance box in Fig. 1 is connected to an ordinary lighting socket. Three wires connect the lamp to the resistor, and when the push switch on the left-hand side of the resistance box is pressed it causes the ionizing filament in the lamp to glow. The arc strikes almost immediately, and the push switch must then be released. Care must be taken in connecting the lamp so that the correct polarity is maintained. The resistance box is so arranged that by means of the two-prong plug shown in the middle of the box it can be employed for any voltage from 100 volts to 250 volts.

Referring to the diagram shown in Fig. 2, the operation of the lamp is briefly as follows: The current first passes through the ionizer circuit *BB'*, causing the filament to incandesce at a temperature sufficient to ionize the gas between it and the positive electrode *E*. At first a small current flows in the arc circuit, this current rapidly increasing until the cut-out is operated. This cut-out breaks the ionizer circuit and the arc is "struck," the striking being assisted by the removal of the ionizer circuit, which, of course, shunts the arc circuit. The heat rising from the arc causes the expansion strip *F* to warp, thereby moving the arc to another position on the ionizer. On switching off the current the electrode returns to its original position, having left the inactive part and coming to rest opposite the still active portion of the ionizer. By this means the lamp may be restarted at any period of its life without difficulty. Practically the whole of the intense white light emanates from a small globule of fused tungsten 0.1 in. in diameter.



FIGS. 2 AND 3—DIAGRAMMATIC AND OUTSIDE VIEWS OF DIRECT-CURRENT TUNGSTEN ARC LAMP

In the construction of the highest candle-power lamps the expansion strip is dispensed with, use being made of the fact that in the cases of the more powerful arcs there is a greater tendency for the arc to pass across the shortest gap. After striking from the filament to the edge of the electrode, the arc rises to the thickened portion immediately opposite.

Where even illumination is required in all directions, spherical electrodes are most suitable. Electrodes can be made of any desired shape, however, and a flat base or disk mounted vertically is said to be an ideal light

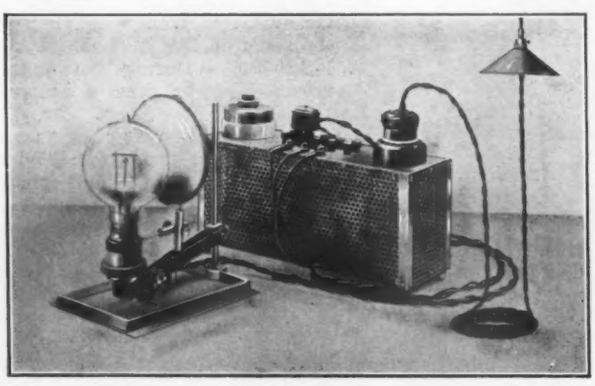


FIG. 1—LAMP WITH REFLECTOR READY TO BE INSERTED

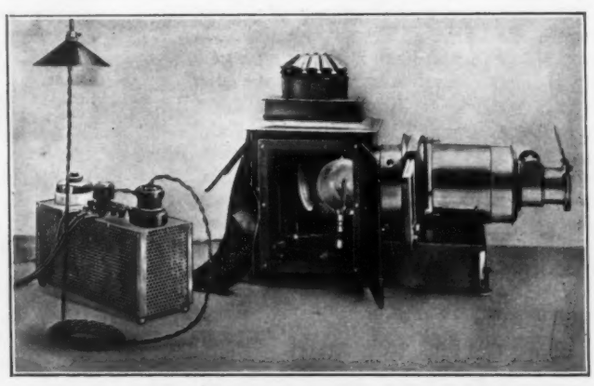


FIG. 4—LAMP INSERTED IN PROJECTOR LANTERN READY FOR USE

source for projecting purposes. The lamp is so well adapted for projection work that there is every reason to believe, it is claimed, that it will supersede all other sources of light for this purpose. It gives a constant and uniform screen illumination, while there is no flickering and danger of fire. The bulb of the lamp, although smaller, does not become so hot as that of the 0.5-watt metal-filament lamps. The lamp requires no attention while burning, so that the whole of the operator's time is free to attend to his apparatus. Lamps of 1000-cp. to 2000-cp. ratings are suggested as suitable for motion-picture work, and lamps of 200-cp. to 300-cp. ratings for ordinary lantern work. Various models of the lamp are being prepared by the Edison & Swan company for use in motion-picture lanterns, search lanterns and for other technical purposes.

Monogram-Clock Control Apparatus

The Reynolds Electric Company of Chicago and New York has just completed a very intricate controller for a monogram clock built by the Gillette Electric Company for a prominent sign company in Havana, Cuba, as shown in the accompanying illustration. The switching apparatus consists of seventy-six individual switches, controlling a like number of circuits in four monograms, flashing on the time of day or night. The gearing in itself is very intricate, inasmuch as there are numerous cams, one-tooth gears and Geneva movements, since it is necessary to revolve the lower cylinder once every minute, the middle cylinder once every hour and the top cylinder once every twelve hours. Accurate timing gears are therefore essential, and this mechanism is built so that it will not vary a fractional part of a second. One of the two switches on the right, next to the gear housing, controls the relay, which in turn is controlled by the master clock. The other switch controls the motor circuit, the latter starting and stopping once every sixty seconds, thus making the motor duty extremely severe. The entire mechanism is built specially for this work and represents an unusual engineering feat. Particular attention is directed to the motor, which is also specially designed on account of the peculiarities of its service. It is of the 220-volt, single-phase induction type, rated at 1/16 hp. Contrary to precedent, the motor is constructed without a cut-out or starting switch, and while the windings consist of both starting and running coils, in order to eliminate any possible switch trouble due to the frequency of starting and stopping, the stator has been wound so that no internal starting switch would be required in the winding circuit. The starting torque of the motor has not been affected by this change and no "arc" or "flash" is caused, it is claimed, by the opening of the ordinary centrifugal acting switch.

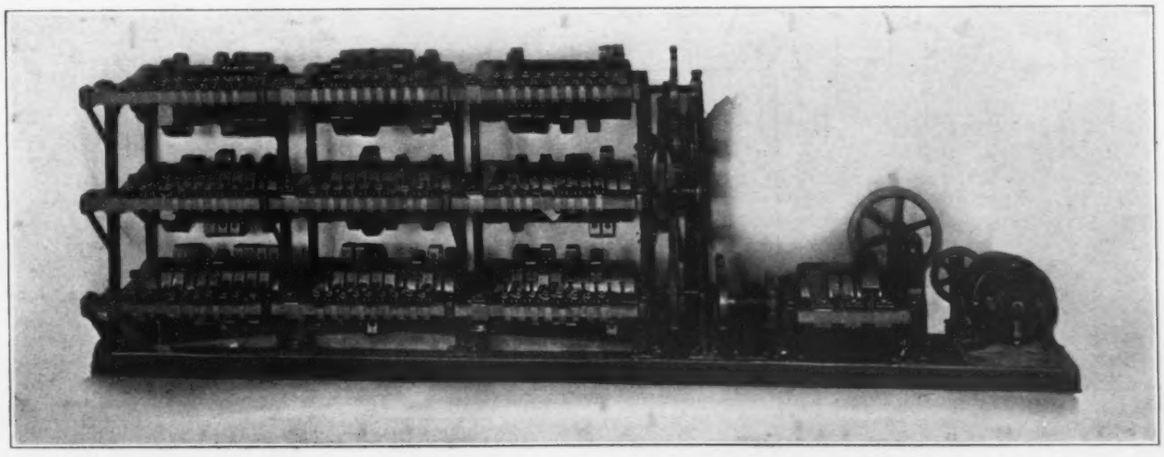
Four-Pole Motors for Driving Ventilators

For driving its directly connected ventilating apparatus at a variety of speeds, the B. F. Sturtevant Company, Boston, Mass., will use a line of four-pole motors designated as type D, ranging in rating from 7 hp. to 50 hp., instead of the type H four-pole motors heretofore employed. The new machines are especially designed for continuous service at full load for operating fans, exhausters, high-pressure blowers, air compressors and pumps. They may also be adapted for driving printing presses, machine tools, laundry machines, hoists and elevators, or any other type of machine requiring a constant or variable drive. Particular attention is directed by the manufacturer to the accessibility of the brush-gear brushes and commutator of these machines, which make them useful also as generators.

FOUR-POLE VENTILATING MOTOR

The motors are being made in the inclosed or water-tight form for operation in dusty or damp places or out in the open and in the semi-inclosed type for use in machine shops, where there is a continual hazard from falling objects. The machines are also being built so that two of them can be connected together and operated as balancer or motor-generating sets. In the development of the machines the manufacturer points out that special attention has been paid to the commutator characteristics as well as to the selection of brushes.

The armature is constructed on a cast-iron spider keyed to the shaft. The armature core is built up of soft annealed steel punchings, each insulated by a coat of japan. Ventilating slots are provided to permit free circulation of air. The commutator is built up separately and then mounted directly on the armature spider. The bars are of hard-drawn copper insulated from each other by mica and insulated from the supporting rings by mica rings and bevels. The end cases which carry the bearings are of skeleton construction clamped to recesses in the magnet frame by four bolts and are spaced equally so that the motor may be bolted to the floor or ceiling without additional machine work. Each end of the housing is provided with an aluminum oil catcher which is so constructed that



INTRICATE MOTOR-DRIVEN CONTROL APPARATUS FOR OPERATING MONOGRAM CLOCK

there will be no leakage of oil along the shaft to the armature and commutator of the machine. The outer end of the bearing housing on the commutator end is entirely closed up by a cap. An aluminum cover is provided over the oil-ring opening and is of such design that it will close itself automatically, thus preventing dust and dirt getting into the bearing. An overflow oil bearing is provided so that oil will not flow over into the machine while replenishing.

The brush ring is clamped over the bearing housing and the brush is rigidly locked in place by a substantial bolt. The brush studs are clamped into brackets with metal-to-metal contacts, thus securing against the liability of the bolts getting loose from the shrinkage of insulating materials. The brush holders, of recent design and known as "Sturtevant universal" brush holders, are so arranged that the brushes can be adjusted during the operation of the machine without relieving the tension on them. They can also be removed for inspection without changing the tension. The tension is regulated by a ratchet wheel of such design that the notches will not wear out, it is asserted, and the spring is always securely locked in position. These tension springs are of phosphor bronze.

Large-Size Porcelain Socket

A porcelain socket of the "Mogul" type fitted with a cast-iron yoke has recently been developed by Harvey Hubbell, Inc., Bridgeport, Conn. The yoke is tapped for ⅜-in., 1.5-in. or 0.75-in. pipe or rod as desired. The sockets are especially suited, it is pointed out, for general outside illumination where sockets which can be threaded directly to the ends of solid arms or brackets are required. The design of the yoke permits ample room for the conductors to be strung from the socket to the

PORCELAIN SOCKET WITH CAST-IRON YOKE

feed wires instead of drawing them through conduit or the supporting arm of the fixture. Conductors can be easily attached to large-head binding screws and led through an opening in the top of the porcelain, thence diverging to either side of the iron bracket for attachment to the feeder. Sockets of the type shown are also considered desirable for use in inclosed or husk work, since the convenience in wiring and the ease of attachment reduce assembling and wiring costs.

Dustproof Commercial and Industrial Lighting Fixture

A lighting fixture in which are combined the advantages given by a diffusing bowl and a shade, and in which ample ventilation is said to be given in spite of the fact that the lamp is totally inclosed in a dustproof globe, is being

FIG. 1—DUST-PROOF FIXTURE WITH CHAIN SUSPENSION

marketed by the Beardslee Chandelier Manufacturing Company of 216 South Jefferson Street, Chicago, under the trade name of "Denzar."

The fixture consists essentially of a ventilated porcelain-enameled cast-iron holder, a white opal-glass shade attached to the holder by three holder screws, and a lower bowl. The principal features of the fixture are centered about this lower bowl. It is made of a single piece of glass, the top portion of which is of clear glass, constructed with a reverse curvature. The bottom portion of the bowl is made of the same clear glass, coated on the outside with an indestructible diffusing enameled

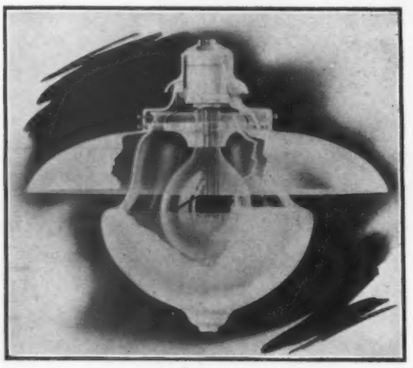


FIG. 2—PHANTOM VIEW OF DUST-PROOF FIXTURE

finish. The bowl is suspended from the holder instead of from the shade, as is the usual practice, so that no supporting rods are needed between the bowl and the shade.

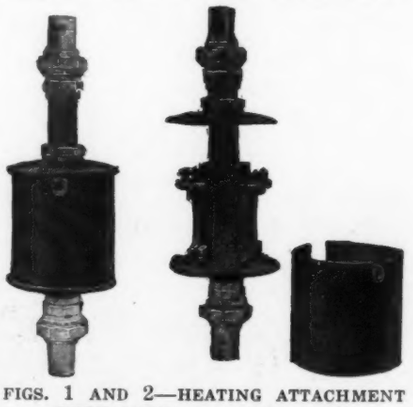
Since the bowl is made of a single piece of glass, no openings are available for admitting dust or insects. Whatever dust particles may settle on the reverse curved clear-glass surface of the globe may be wiped off with a cloth or a feather duster without disassembling the fixture. At the base of the lamp a steel baffle plate, white-enameled and designed to carry out the contour of the shade and give a finished appearance to the fixture, catches that small portion of light sent upward by the lamp and reflects it to the bowl.

The fixture is now being made in suitable sizes for accommodating 200-watt, 300-watt, 400-watt and 500-watt lamps. A size suitable for 100-watt lamps will be ready in a short time. In the smallest-sized unit a 14-in. shade and an 8-in. globe will be used with a 5-in. fitter. For the medium sizes the shade measures 17 in., the globe 10 in. and the fitter 6 in. Dimensions for the largest unit are: Shade, 20 in.; bowl, 12 in., and fitter, 7 in.

In buildings of saw-tooth construction, and other structures where the illumination of the ceiling is not desirable, 26-in. and 19-in. radial steel reflectors are used in these units instead of opal-glass shades. The illustrations herewith show the complete unit and a sectional view of its interior construction.

Electric Water Heater

An interesting electric household appliance which is particularly well adapted for use where electric service rates are low is the water heater shown



FIGS. 1 AND 2—HEATING ATTACHMENT WITH COVER ON AND REMOVED

herewith, which may be attached to an existing supply system in connection with a water tank as shown in Fig. 3. Referring to Fig. 3, the heater *A* is mounted on a circulating pipe connected to the top and bottom of a water tank *B* as shown. As the water becomes heated it tends to rise and is delivered into the top of the tank. At the same time the cold water flows into the circulating pipe from the bottom of the tank. Thus a continuous circulation is maintained, and the water in the tank is gradually heated from the top downward. Hot water is drawn off through pipe *D* and cold water enters through pipe *C*. The circulation is said to be sufficiently slow to allow hot water to be drawn off a few minutes after

switching on the current. Provision is made for removing deposits in the circulating pipe through the plug *E*. The heater is fitted with two 1.25-in. screwed unions to allow it to be quickly removed and replaced. Heating attachments for existing water tanks are fitted with covers as shown in Figs. 1 and 2. These heating outfits are being made in five different types, type No. 1 having a tank with a capacity of 23 gal. and a heating unit rated at 350 watts, type No. 2 a tank with a capacity of 23 gal. and a heating unit rated at 500 watts, type No. 3 a tank with a capacity of 34 gal. and a heating unit rated at 350 watts, type No. 4 a tank with a capacity of 34 gal. and a heating unit rated at 500 watts, and type No. 5 having a tank with a capacity of 34 gal. and a heating unit rated at 700 watts. The heating attachments are 6 in. wide, 6 in. deep and 18.25 in. high, and have a net weight of 24 lb. The water heaters are being

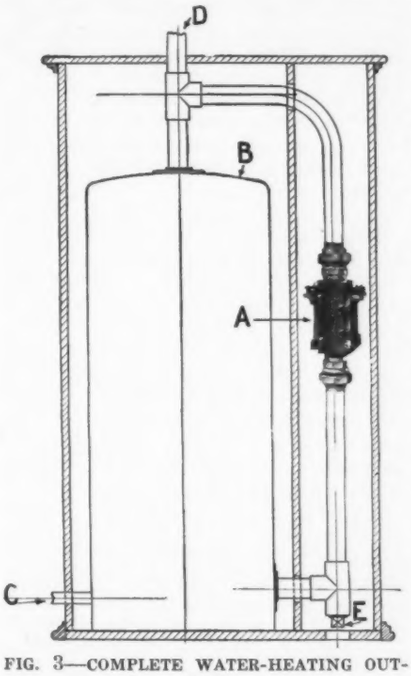


FIG. 3—COMPLETE WATER-HEATING OUTFIT

placed on the market by Ferranti, Limited, Central House, Kingsway, London, W. C., England.

Combined Potential and Current-Metering Transformers

Combination potential and current single-phase metering transformers for outdoor service are being made by the Packard Electric Company of Warren, Ohio. The current and potential elements are mounted within cast-iron cases and entirely immersed in oil. Form-wound coils with double cotton-covered wire are used and each layer is properly spaced for the operating voltage and is treated with varnished cloth. The top turns of the coils are reinforced with flexible mica pads wound in between coil layers to give additional insulation to protect them against line surges which may be caused by high-tension switching or by lightning. The cores are made of silicon-alloy steel of double cruciform section, which gives sixteen oil-circulation ducts between the coils and the core.

The terminals of the high-voltage coils are carried through the case in specially designed triple-petticoat, two-piece porcelain bushings. The bell-shaped part of the bushing extends from the case and affords ample mechanical strength and sufficient leakage

FIG. 1—OUTSIDE VIEW OF WEATHERPROOF METERING TRANSFORMER

surface, it is pointed out, to protect the leads from grounding even during very severe weather conditions. Inside the case the protector part of the bushing covers the leads and removes all possibility of the leads being shoved against the case cover. The cases are equipped with lugs and hangers for standard cross-arm mounting.

For single-phase metering one transformer is required, and for polyphase work two transformers may be used connected in standard open delta on the high-tension side. The rating of the potential element in stock transformers is 50 watts and that of the current element is 30 watts. At full load the secondary potential is 110 volts and the current 5 amp. These voltage and current values have been made standard to permit the use of standard 5-amp., 110-volt watt-hour meters with a multiplying constant. The watt-hour meter may, of course, be mounted at an ac-

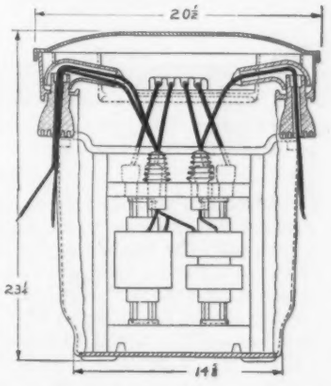


FIG. 2—SECTIONAL VIEW OF TRANSFORMER

cessible and convenient point in a weatherproof cabinet and the secondary leads of the transformer carried to it. To facilitate reading of the instruments a common 10-watt, 110-volt lamp may also be installed in the meter cabinet and operated from the potential wires.

Electric Pump for Pneumatic Water Systems

The Goulds Manufacturing Company, Seneca Falls, N. Y., has just brought out a new air attachment designated as "Fig. 1670" for use with its "Fig. 1454" deep-well electrically operated working head, adapting the pump for use with pneumatic water-supply systems as well as with elevated-tank systems. The attachment is made only for the smaller size of this pump, which has an adjustable stroke of 6 in., 8 in. and 10 in. This attachment, which is shown in the illustration mounted on the pump, consists of a brass cylinder with leather-crimp-packed plunger and cast-iron operating yoke, bolted to the crosshead on the pump. The plunger of the air attachment should always be adjusted to suit the stroke of the pump. That is, if the pump is set for a stroke of 8 in., the attachment plunger should also

AIR ATTACHMENT MOUNTED ON PUMP

be set for a stroke of 8 in. Two spacing pieces which are shown under the nut at the top of the air-attachment plunger rod are furnished for this purpose and are all that is needed for making this adjustment. The "Fig. 1454" working head shown is furnished for heads up to 300 ft. and capacities up to 26.8 gal. per minute.

Portable X-Ray Power Plant

It is probably safe to say that at no time since its first application to medical science has the X-ray played so important a part as it is doing at the present time in the European war in connection with the work of saving the lives of wounded soldiers who but for the prompt diagnosis it permits would succumb to their wounds. Not only are all the military hospitals equipped with such apparatus, but a large number of traveling hospitals in the form of specially designed motor vehicles are also being used near the field of battle by the various medical corps. One of the

needs that the war early brought out in connection with the use of the X-ray was that of a portable power plant which could be quickly installed either in a motor vehicle or in hospitals not provided with a source of electrical energy. One of these sets shown here-

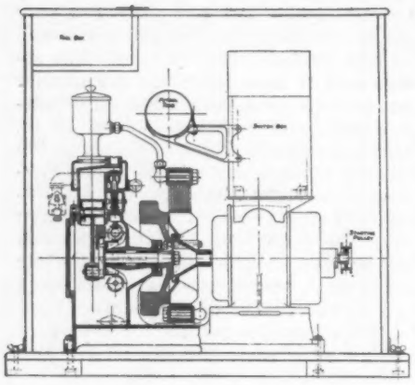


FIG. 1—DIAGRAMMATIC VIEW, PORTABLE X-RAY POWER PLANT

with and made by the Austin Motor Company, Ltd., of Northfield, Birmingham, England, is specially designed for this work, and a number of them have been supplied to the director-general of the British army medical service.

The set, which is exceedingly compact, occupying a space of only 3 ft. by 2 ft. by 3 ft., comprises a single-cylinder gasoline engine developing 1.5 hp. at a speed of 1300 r.p.m., radiator, muffler, gasoline tank, dynamo and switch box, the whole, for the sake of portability, being inclosed in a wooden box provided with carrying handles and also with a receptacle for the necessary tools. The engine has a bore and stroke of 2.5 in. by 3 in., and the crank case, which is of aluminum, is formed in one piece with the dynamo bed-plate, thereby constituting a rigid bed. The ignition is by high-tension magneto, and

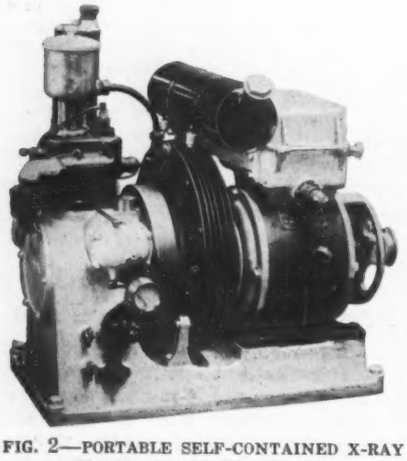


FIG. 2—PORTABLE SELF-CONTAINED X-RAY PLANT FOR ARMY SERVICE

the lubrication by pump circulation; the cylinder is provided with a water jacket, the water, which is circulated by pump, being carried in a small tank above the engine. For cooling purposes an interesting form of radiator is employed, consisting of six sections or disks embracing a rotary fan fixed to the flywheel. The gasoline tank, which is centrally placed above the radiator, has a capacity of 1 gal., which is said to be sufficient for a continuous run of about seven hours.

The dynamo or generator, as has already been stated, is mounted at the side of the engine on an extension of the crank case. It is of the reverse compound-wound type, having an output of 10 amp. at 70 volts, and is directly driven by the engine. The latter is put in operation by means of a pulley on the rear end of the dynamo spindle, the necessary initial impetus being given by a strap working on the pulley. In order that the engine shall run at a constant speed, it is fitted with a centrifugal governor, which acts on the throttle valve in the carburetor. The governor and its springs are so designed that there is a very small rise in the speed between full load and no load, while by means of a knurled nut and an adjustable spring the engine speed can be varied between wide limits.

The switch gear, which is entirely inclosed in an aluminum case mounted above the dynamo, is of the rotary type and furnished with outside operating handles. It is arranged to give any of the following combinations: (1) Off position, (2) battery to X-ray coil, (3) battery charging and dynamo and battery in parallel to X-ray coil, (4) dynamo and X-ray coil only, (5) battery and dynamo in series to X-ray coil. The voltages to the coil are approximately: No. 2 position, 36 volts; No. 3 position, 36 volts to 45 volts; No. 4 position, 75 volts, and No. 5 position, 110 volts.

Improved Electric-Vehicle Batteries

A recent development in "Ironclad-Exide" batteries for electric pleasure and commercial vehicles, storage-battery mine locomotives and industrial trucks consists of an air-tight cell cover and filling-plug construction, which, the

FIG. 1—CROSS-SECTION OF CELL COVER, SHOWING PLUG REMOVED

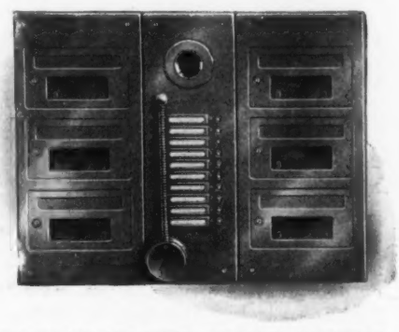
manufacturer declares, have many new and distinct advantages. The cover is made flush with the top of the jar, leaving no space for the collection of moisture or dust or other impurities. The filling plug limits the amount of water that can be put into a cell to the exact amount needed to replace that lost by evaporation. The result is said to be a clean, dry and attractive battery with the liability of short-circuiting, rotting of battery trays or corrosion of metal parts eliminated. The cover is fastened around the cell terminals by special sealing nuts which are threaded to the terminals, and the rubber washers used in connection with the sealing nuts make air-tight joints. The cover and filling plug of the type described above have already been employed in hundreds of thousands of "Exide" starting batteries, the manufacturer points out, where they have proved very successful. They are being used in connection with the "Exide" batteries which have been furnished to the United States gov-

FIG. 2—CROSS-SECTION OF CELL, SHOWING PLUG IN PLACE

ernment for modern submarines. The new and improved construction has been limited by the manufacturer, the Electric Storage Battery Company, Philadelphia, Pa., to its type MV "Ironclad-Exide" batteries.

Vestibule Telephone Set

Of particular convenience for apartment-house use is the telephone set shown herewith, which may be installed in vestibules and used in connection with ordinary mail boxes as shown. The No. 83 and No. 84 vestibule telephones, as they are called, are fitted with watch-case receivers, the No. 84 outfit also being provided with a flexible armored receiver cord to protect the telephone receiver from theft. The receivers are so mounted that they do not hang over the card holders and hide the names from view. A standard long receiver can be employed if desired, but it is usually considered too bulky for vestibule use. The telephones are mounted at the same height as the letter boxes and are carefully insulated against short-circuits. The working parts are mounted as a unit to the back of the telephone and are protected with a heavy close-fitting steel box. In case of increase, a new letter box unit can be added to the vestibule set. All telephones are fitted with large card holders, and push-buttons can be numbered if desired. Use is made of an unbreakable metal mouthpiece which is permanently attached to the front plate, thus



TELEPHONE SET WITH ARMORED RECEIVER CORD

insuring the mouthpiece also against theft.

The outside dimensions of these sets vary from 15 in. by 12 in. to 15 in. by 106 in. The sets are being placed on the market by the Connecticut Telephone & Electric Company, Meriden, Conn.

NEWS OF THE INDUSTRY

A Review of Activities in the Electrical Manufacturing, Selling and Central-Station Fields

Supply Manufacturers Entertain Underwriters

On Wednesday evening, Jan. 26, 1916, the board of governors of the Associated Manufacturers of Electrical Supplies entertained at dinner at Delmonico's the chairmen of the various sections of the association, in order that they might then meet socially W. H. Merrill, Dana Pierce and A. R. Small of the Underwriters' Laboratories, Inc., as the special guests of the board. Details of this meeting have just come to hand. The gentlemen present at that gathering were: W. H. Merrill, manager, Dana Pierce, electrical engineer, and A. R. Small, superintendent of label service, of the Underwriters' Laboratories, Inc.; LeRoy Clark, representing the wire and cable section; E. B. Hatch of the molded or formed insulation section; S. Morris of the snap-switch section; N. L. Otis of the outlet-box section; W. C. Robinson of the interior-conduit section; B. E. Salisbury of the lamp-receptacle and socket section; H. R. Sargent of the fuse section; J. H. Trumbull of the knife-switch section; J. E. Way of the porcelain section; R. K. Sheppard, president, J. W. Perry, treasurer, C. E. Dustin, general secretary, and T. M. Debevoise, counsel, of the Associated Manufacturers of Electrical Supplies; L. W. Downes, D. C. Durland and J. F. Kerlin.

After the dinner the counsel of the association, Thomas M. Debevoise, described interestingly the activity which has prevailed during the past few months in the organization of the different sections of the body. Those sections now are ten in number, including besides those named above the panelboard and switchboard section.

Directly following this talk, B. E. Salisbury, president of Pass & Seymour, Inc., a member of the board of governors and chairman of the lamp-receptacle and socket section, addressed the gathering relative to the needs of the different sections for co-operative and intimate work with the Underwriters' Laboratories, Inc. He explained to the guests of the association the needs and the hopes of the sections relative to their future work with the Underwriters' Laboratories.

Responding to the remarks of Mr. Salisbury, W. H. Merrill, manager of the Underwriters' Laboratories, Inc., described graphically a practical method by which through the establishment of industry conferences every branch of the electrical manufacturing industry that has need of co-operation with the Underwriters' Laboratories may obtain complete harmony and develop standardization that will inure beneficially to the manufacturers, to the public, who are the customers of the manufacturers and of the fire underwriters, and to the fire underwriters themselves, who are the special clients of the Underwriters' Laboratories, Inc.

Capping effectively the invitation of the laboratories to the various sections of the association, LeRoy Clark, president of the Safety Insulated Wire & Cable Company and a member of the board of governors, closed the speaking by describing the work and the success of the Rubber-Covered-Wire Industry Conference, which has linked together the rubber-insulated-wire manufacturers and the Underwriters' Laboratories for many years.

The gathering gave to the chairmen of the sections an intimate knowledge of the advantages to be gained by their sections through co-operative work with the laboratories.

November Exports of Electrical Goods

The exports of electrical goods manufactured in the United States for November, 1915, and for the first eleven months of 1915, as reported by the Bureau of Foreign and Domestic Commerce, were much larger than during the same period a year earlier. The accompanying table shows the comparative amount of exports for the two periods in 1914 and 1915.

The November, 1915, exports it will be noted, are larger than the 1914 value by more than $1,000,000, and for the first eleven months of 1915 exports are greater than for the 1914 period by almost $4,000,000. Since these figures, however, give values and not quantities, the comparison is somewhat misleading. The 1915 prices since the beginning of last September are almost all higher than those for 1914. It is not known to what extent this would affect comparisons because a good many of the 1915 orders were made when prices were lower. It is true, nevertheless, that the volume of exports need not change from now on and yet the values compared with those of a year previous would be very much greater and would apparently show a consistent gain in the export of electrical goods.

ELECTRICAL EXPORTS FOR NOVEMBER AND FOR ELEVEN-MONTH PERIOD

Articles Exported	November		Eleven Months Ended November	
	1915	1914	1915	1914
Batteries	$184,903	$44,136	$1,254,835	$576,575
Dynamos or generators	58,850	112,784	1,755,808	2,110,491
Fans	55,849	3,825	353,805	282,182
Insulated wire and cables	302,089	78,652	2,586,723	1,229,305
Interior-wiring supplies, etc., including fixtures	79,580	53,189	806,014	536,300
Arc lamps	2,115	860	20,576	42,040
Carbon-filament lamps	13,186	5,408	126,166	84,063
Metal-filament lamps	98,703	22,379	752,864	214,003
Meters and other measuring instruments	85,113	32,061	588,666	136,186
Motors	293,540	337,792	3,045,924	3,029,647
Telegraph instruments (including wireless apparatus)	12,154	3,350	122,689	91,445
Telephones	30,308	143,777	822,840	1,138,161
Transformers	170,632	115,955	653,896	872,215
All other	1,357,825	690,555	9,240,366	7,999,939
Total electrical machinery, etc.	$2,744,847	$1,644,723	$22,131,172	$18,342,552

Co-operative Merchandising on Pacific Coast

On Feb. 3 the Portland Section of the National Electric Light Association and the American Institute of Electrical Engineers held its eighth bi-weekly luncheon, and about sixty-five members braved the storm to be on hand.

George Pervis of the Hurley Machine Company, Chicago, gave a short talk on electric washing machines, confining his remarks to a general summary of the washing-machine situation. Mr. Pervis told the members present that the most effective place for a machine

was where it could be demonstrated that the user could turn into a more profitable channel the effort expended on washing. Mr. Pervis said that while washing machines were frequently necessities in large households, yet oftentimes they were still more essential in smaller households where women could not afford servants. Mr. Pervis also stated that women who were doing outside housework could materially increase their earning time by eliminating some of the more tedious household work such as washing. He said that it had been his experience that the average life of the washing machine was about eight years, although some machines lasted only four or five years, and he had recently seen a machine in Portland that had operated for twelve years and was still in good order and giving satisfactory service.

William Goodwin, general sales manager of the Pacific States Electric Company, with headquarters in San Francisco, gave a vigorous and pointed talk on co-operation in California between manufacturers, contractors, jobbers and central stations. Mr. Goodwin's remarks were not of the stereotyped variety, but brought out forcefully many new points. He contended that at the present time in most parts of the country there was practically no co-operation and that most of the discussions on that topic were full of platitudes. The only way to co-operate was to formulate hard and fast principles that would accomplish the ends desired, getting every section of the industry together on a solid working basis for the benefit of all.

Public Service Commission News

Pennsylvania Commission

The Pennsylvania Public Service Commission has decided that where a public-service company was chartered prior to the enactment of the law creating the commission the latter body has in the exercise of its police power the authority to restrain the company from making a contract for lighting the streets of the municipality covered by its charter after the contract has been approved by such municipality. The decision was given in the action between the township of Jenkins and the Jenkins Township Electric Light, Heat & Power Company. However, the disapproval of the contract in no way impairs any of the charter rights of the corporation. The contract was disapproved because there was already an electric-lighting company doing business in the town, while the company under consideration was not engaged in supplying electrical energy. The commission, therefore, would not permit what it termed "a ruinous competition" to be established in a municipality.

New York Commissions

The Public Service Commission of the Second District of New York has ruled that the Fulton Light, Heat & Power Company has the right to run transmission lines from Fulton to Phoenix along the West River Road and passing through the northeast corner of the town of Lysander, provided that it does not supply energy for either power or lighting in what is known as North Phoenix. It was further stipulated that the company should not interfere with the territory controlled by the other concerns. The action grew out of the opposition of the Seneca River Power Company and the Oswego River Transmission Company to the passage of the lines of the Fulton company through territory in which they held franchises. During the discussion the commission sharply censured the Seneca River Power Company and the Oswego River Power Company for their apparent interchanging actions, pointing out that the companies were practically identical, but that franchises made out to one company were turned over to the other and vice versa.

Indiana Commission

The Public Service Commission of Indiana has authorized the purchase of the General Service Company and the Indiana Lighting Company by the Northern Indiana Gas & Electric Company. The headquarters of the latter company are at Hammond, Ind., and C. H. Geist, owner of the majority of the stock in the Indianapolis Water Company, is the owner of the majority of the stock in the Northern Indiana Gas & Electric Company. The consideration for the purchase of both companies was $5,400,000 and the assumption of the various indebtedness of the companies involved. The merged company will hereafter supply electricity, water and gas to many northern Indiana and Ohio towns and cities. The commission's order also authorized the issuance of $5,400,000 in bonds by the Geist company for the purchase of the two companies, which formerly had been under the control of what is known in Indiana as the Murdock interests. The merger authorization is the biggest deal of its sort in Indiana in many years. A total of approximately $23,000,000 in securities was involved. The commission, in a group of conditions which it stipulated as corollaries to the order's actual provisions, declared that it retained all rate-making powers in each of the cities that are concerned in the merger.

The cities that will be supplied by the united company hereafter are as follows: Lafayette, West Lafayette, Fort Wayne, Logansport, Wabash, Peru, Frankfort, Lebanon, Bluffton, Ossian, Decatur, Crawfordsville, East Chicago, Indiana Harbor, Michigan City, Hammond, Chesterton, Whiting, Porter, Aetna, Dyer, Griffith, Highland, Munster, Schererville, South Bend, Mishawaka and Plymouth, all in Indiana, and Lima, Wapakoneta, North Mercer, St. Mary's, Greenville and other places in Ohio.

Under the order of the commission "the total consolidated properties will have the fixed charges arising from $18,036,000 of bonds and notes issued and assumed by the Northern Indiana Gas & Electric Company and a gross income from the consolidated properties of $1,186,758.41." Of these bonds and notes now existing, only $282,000 bear 6 per cent, but the issue of $5,400,000 also will bear 6 per cent, making a total of $5,682,000, upon which 6 per cent interest will be $340,920 annually.

The commission said that "after the fullest publicity" not a single objection in any of the municipalities affected had been heard to the merger and that the only objection made "by parties who have any interest whatever in this proceeding" was from twenty business men of Lafayette. The commission went on:

"It is urged that it is against public policy to permit the consolidation of these properties. Neither the courts nor the Legislature of this State has so declared. Upon the contrary, in recent years the Legislature has enlarged the power of railroads of this State to take over other lines of railroads. In 1903 it passed the statute enabling these very utilities to consolidate. It passed an act a number of years ago under which one holding company is operating more than forty of these utilities in this State. The Shively-Spencer utility commission act is itself a plain declaration of the public policy of this State. The public policy of a state is declared, not by public rumor or the expression of individual citizens, but by the constitution and legislative enactments and by the decisions of the highest judicial tribunals of the state."

Average 1915 Residential Bill in Detroit $18.90.—Alex Dow, president of the Edison Illuminating Company of Detroit, says that the average electric bill in Detroit for residences during 1915 was $18.90. The average bill for 1914 was $19.50.

Chicagoans Hold 80 per Cent of Commonwealth Edison Stock.—Of a total of 2968 stockholders of the Commonwealth Edison Company, 72 per cent are residents of Chicago and their holdings comprise 80 per cent of the issued stock of the company.

Municipal Plant Might Be Sold to Reduce Appropriations.—The town of Wakefield, Mass., is considering, through its special committee on taxation, a plan to sell the municipal lighting plant in order to reduce the expenditures for appropriations.

Preparing for Consolidation.—The Defiance Gas & Electric Company on Feb. 4 filed an application with the Ohio Public Utilities Commission for authority to purchase the property of the Maumee Valley Electric Company and to sell additional securities amounting to $893,400, from the proceeds of which it is to pay for the property.

Bill to Permit Leasing Space in Baltimore Conduits.—The city solicitor of Baltimore, Md., has prepared a bill authorizing the Baltimore Electric Commission to rent space in the city conduits to all applicants. As matters now stand, the city, under a ruling of the Court of Appeals, cannot lease space in its conduits to persons or corporations not having franchise rights in the beds of the streets.

Kansas Municipality Goes Back to Private-Plant Service.—The town of Bucklin, Kan., has decided to shut down its municipal plant and take service from the Midland Water, Light & Ice Company, situated at Dodge City, 30 miles away. The extension will cost $20,000 and is expected to be in operation by the middle of March. The rate for service from the private plant will be 25 per cent less than the municipal-plant rates.

Appraisal Force of Ohio Public Utilities Commission Reduced.—Thirteen appraisal engineers and clerks have been dismissed by the Ohio Public Utilities Commission because of the fact that but little of the $25,000 appropriation for appraisal purposes remains. All but two of these men have been at work on the appraisal of the property of the Cleveland Electric Illuminating Company. Additional funds will be available July 1, but new appointments must be made at that time.

Specific Consumption of Gas-Filled Tungsten Lamps.—A series of experiments made by Ralph C. Robinson on gas-filled tungsten lamps revealed that while the mean horizontal watts per candle-power are very different for different mountings of the filament, the watts per spherical candle-power are practically constant, about 0.8. The mean horizontal watts per candle-power were as follows for the different filament mountings: V-shaped, 0.66; vertical, 0.595; horizontal, 0.82, and diagonal, 0.635.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Amazing Growth of Copper Production in Twentieth Century.—The production of copper in the United States amounted to 2,998,440 long tons in the nineteenth century. In the first fourteen years of the twentieth century the production was 5,927,926 tons, or double that produced in the nineteenth century. Of the total world's production of copper of 19,977,682 long tons, 10,618,996 tons, or more than 50 per cent, was produced in the first fourteen years of this century.

Recommends That Submarine E-2 Be Used as Storage-Battery Test Laboratory.—Findings of the Court of Inquiry which investigated the explosion on board the submarine E-2, reported to have been due to ignition of hydrogen gas generated by the nickel-iron storage battery, have been filed with Secretary Daniels, who has refused to make the report public. The Secretary did state, however, that the court recommended that continued experiments be made with the new nickel-iron storage battery, and that the submarine E-2 should be used as a laboratory for the continuance of these experiments.

Ten per Cent Residential Rate Reduction in Providence, R. I.—A reduction of 10 per cent in rates for residence lighting throughout Providence, R. I., has been agreed to by the Narragansett Electric Lighting Company, following negotiations with the special committee of the City Council charged with the matter. The present rate of 10 cents a kilowatt-hour will be reduced to 9 cents, and the reduction, if ratified by the City Council, will become effective July 1, 1916. Reductions were also made in the rates for lighting the city streets which will mean a saving to the city of over $15,000 per year on its lighting bill.

Nebraska Intervenes in Western Forestry Reserve Power Cases.—Following the lead of Colorado, Utah, Idaho, Nevada and Oregon, the State of Nebraska, through its attorney-general, has intervened in the power cases brought by the federal government to enjoin the operation of power plants which are situated wholly or partly within forest reservations. The first of these cases that comes before the Supreme Court of the United States is against the Beaver River Power Company, a part of whose system is situated within what is now known as the Fillmore National Forest. It is understood that the principal struggle will come between the federal government and the State government and that the Supreme Court will have to decide whether the operation of utilities over public lands is a function of the State or the federal government.

Rochester Company to Make Concentric-Wiring Test.—A practical working test of concentric wiring is soon to be made in Rochester, N. Y., by the Rochester Railway & Light Company, with a view to adopting the use of the wire should it prove satisfactory.

Bills Affecting Electrical Industry in Kentucky Legislature Favorably Reported.—A bill to permit electrical companies to use the country highways has been favorably reported in the house of the Kentucky Legislature, as well as the workmen's compensation measure.

Power Required for Electric Heating.—For heating a room with electric radiators S. Wilkinson stated before the British Institution of Electrical Engineers that, on the average, 1.5 watts to 2 watts per cubic foot of air space was the necessary amount of power required.

Edison's Birthday Celebrated at His Birthplace.—On Feb. 11 Thomas A. Edison's sixty-ninth birthday was quietly celebrated at Milan, Ohio, his birthplace. Appropriate exercises took place in the schools, and the older residents of the town gathered and discussed the events in the early life of the inventor. His pictures were displayed in the windows of business houses and dwellings.

Unpaid Electrical Construction Inspection for Dallas, Tex.—The city of Dallas, Tex., has issued commissions as deputies in the city electrical inspection department to R. E. Wetter, business agent for the Inside Electrical Workers' Union, and to Charles W. Graham, local secretary of the Electrical Contractors' Association, both to act without pay and without the power of condemnation. They are expected to serve the city materially by advice and by assisting in the detection of poor electrical work.

Weather Conditions in 1915 Costly to Cable and Telegraph Systems.—The extraordinary weather conditions of the past year caused considerable expense in the maintenance of cable and telegraph systems, according to Clarence H. Mackay, president of the Mackay Companies. Apparently there was some serious disturbance in the bed of the Atlantic Ocean, it was stated, particularly in the zone where nearly all of the transatlantic cables are laid. The continued severity and uninterrupted violence of the storms rendered repairs slow and expensive.

Thorough Investigation Being Made of Washington Telephone Industry.—Hearings are now being held before the Public Service Commission of Washington covering the rates, rules and practices of the telephone industry in that State. During the past two weeks many sessions have been held in Tacoma, and the principal discussion has been on the valuation of the property of the Pacific Telephone & Telegraph Company. Various appraisals and estimations made by State officials and by the company range all the way from $16,000,000 to $26,000,000. These hearings will be continued for some time, as the commission has in mind a thorough investigation of the situation.

Washington City to Apply for Federal Reserve Power Permit.—The City Council of Everett, Wash., has passed a resolution authorizing the city clerk to make formal application at once to the Department of Agriculture for a preliminary power permit in the government reserve in the territory known as Sultan Canyon. This is the first step taken by the Council to secure municipal power and lighting facilities for the city of Everett.

Large Electric Sign for Insurance Company.—What is reported to be the largest electric sign employed by any insurance company in the world has been erected by the Travelers' Insurance Company on its home office building in Hartford, Conn. Experiments have shown that the sign, which is 120 ft. long with 9-ft. letters, is readily legible at a distance of three miles. The sign bears the single word "Travelers" and is in a position to be seen by all incoming and outgoing railroad passengers.

Central Station Promotes Series of Lectures on Home Economics.—What is proving to be a forceful campaign in popularizing electric household devices is being carried on by the New York Edison Company among the women's clubs of New York City. Arrangements have been made with the Federation of Women's Clubs of New York for a series of six lectures on home economics to be given in the company's model apartment at 124 West Forty-second Street for the members of the various clubs. At the first lecture of the series, which was held during the afternoon of Feb. 9, about 170 women gathered to hear Mrs. Charles Husted Goudiss, editor of the *Forecast*, speak on "Household Efficiency." Miss G. H. Shearer of the Philadelphia Electric Company also spoke, her topic being "Electricity in the Home."

Operating Expenses and Taxes of New York Utilities.—The total operating expenses of sixty-three electric light and power corporations operating in New York State outside of New York City for the year ended Dec. 31, 1914, amounted to $7,306,862, or 56.4 per cent of the gross operating revenue, $12,959,435. This operating ratio was 1 per cent higher than in 1913 and 1.4 per cent higher than in 1912, but was 0.9 per cent below the average covering the seven years 1908-1914 inclusive. The ratio of taxes to gross revenue was the highest it had been in seven years, amounting to 4.9 per cent. The average over the 1908-1914 period was 4.6 per cent. Operating income for 1914 was 38.7 per cent of the gross revenue. In forty gas and electric corporations the 1914 operating ratio amounted to 53.7 per cent in the electric department and 64.8 per cent in the gas department. The taxes in the electric department were 5.3 per cent of the gross electric revenue, and in the gas department 6.5 per cent of the gross gas revenue. The net operating revenue, therefore, for the electric department amounted to 41 per cent of the gross electric revenue, and for the gas department to 28.7 per cent of the gross gas revenue.

Increasing Cost of Copper Affects Term of Lighting Contract.—In considering the renewal of the contract for lighting the streets of Fall River, Mass., the Fall River Electric Light Company through its general manager stated that the company did not care to make a contract with the city for less than five years, calling attention to the fact that the cost of materials was constantly increasing on account of the war, and that copper wire had increased in cost 100 per cent.

A Method for Finding Power-Factor on Three-Phase Circuit with Polyphase Watt-hour Meter.—A simple means of ascertaining the power-factor on a three-phase circuit where a polyphase watt-hour meter of any type is installed is given by W. B. Kouwenhoven as follows: Tan $\phi = \sqrt{3}$ multiplied by the ratio of the time of one revolution of the disk when the meter is correctly connected and registering the given load to the time of one revolution when one of the current coils is reversed. From tan ϕ cos ϕ, or the power-factor, can be obtained by tables.

Data on Niagara Power Possibilities.—F. Austin Lidbury, president of the Niagara Falls branch of the American Electrochemical Society, has appointed a committee of Niagara Falls electrochemists to prepare data for presentation to the foreign affairs committee of the House of Representatives, which is soon to investigate the Niagara power situation. Mr. Lidbury says the great electrochemical plants of Niagara Falls filled the breach caused by the cutting off of the German chemical supply and prevented the crippling of some of the country's greatest industries. He also points out that the Falls industries are an item not to be overlooked in carrying out a preparedness program. Information along these lines will be prepared by the committee. Each member will deal with some special phase of the situation. It is hoped the report will induce the adoption of a bill increasing Niagara diversion for electric-power development.

Seattle Claims Power Site Wanted by Private Company for Production of Nitrogen.—A bill has been introduced in the City Council of Seattle instructing the city engineer to ascertain the advantages of the Suak-Suiattle power site. The city holds prior rights to the site from the federal government, and a short time ago the Forest Service made inquiry of the city's intention in the matter, as a private company desires to develop the site. Another bill introduced in Council declares that it is the intention of the city to proceed with the development of the site and requests the Mayor to notify the district forest service to this effect. C. J. Buck, acting district forester of the Forest Service, states that the American Nitrogen Company has organized to manufacture compounds from atmospheric nitrogen and desires to avail itself of the Suak-Suiattle site for power purposes. It is unofficially reported that undoubtedly the city of Seattle will utilize this valuable site for further power development.

First "Colorado Public Utilities Reporter."—Copy for the first volume of the "Colorado Public Utilities Reporter" has been sent to the printer by the Public Utilities Commission of the State. The volume, which will contain all of the commission's decisions and orders for 1915, will be published annually at a charge of $2.50, the cost of the report.

City of Tacoma and Power Company to Operate Under Mutual Protection Agreements.—The Tacoma (Wash.) Railway & Power Company has filed with the city clerk the power company's acceptance of the power contract and franchises authorized by the City Council some time ago. Under this contract the city's and the power company's plants will be connected for mutual protection in case of the disability of either plant or other contingencies. The Tacoma Railway & Power Company agrees to furnish to the city electrical energy to the amount of 10,000 hp., and the city in return will be required to furnish only the excess power from the Nisqually plant. A condition of the contract is the restoration of the Tacoma Railway & Power Company's power franchise, which was forfeited because the company sold electrical energy for lighting in violation of a charter provision.

Legislation to Be Introduced to Increase Ontario Hydroelectric Power Supply.—Legislation to permit the Hydro-Electric Power Commission of Ontario to proceed with plans for greatly increasing its supply of power will be introduced by the Ontario government at the coming session of the Legislature. For some time past it has been known that the government approved in general of the plans submitted by Sir Adam Beck for a great power development scheme at Niagara Falls, but not until Feb. 10 was formal announcement made that definite action would be taken this session. The announcement was contained in the following statement: "The government of the Province has been considering the question of providing additional electric power from Niagara and has had placed before it the results of investigations by the engineers of the Hydro-Electric Commission. It appears from these reports that to-day the municipalities in western Ontario are using all the electrical energy which was contracted for by the commission and that within the next five years an additional 100,000 hp. will be required. The government has determined to meet the situation and at the forthcoming session of the House will submit legislation authorizing the supply of such additional power as may be required." The plans submitted to the government by Sir Adam Beck dealt in detail with a scheme that would provide the Province with a development of 250,000 hp., with an ultimate expansion to over 500,000 hp., sufficient to take care of all demands of expanding industries and radical consumption for many years to come. It is estimated that power will not be available in less than three years.

Newark Jovian League.—The mid-winter rejuvenation of the Newark Jovian League was held on Jan. 28, ten candidates being admitted. The New York degree team officiated.

Spring Meeting, A. S. M. E.—The spring meeting of the American Society of Mechanical Engineers will be held at the Hotel Grunewald, New Orleans, La., from April 11 to April 14.

Louisville Jovian League. — The annual election of officers of the Louisville (Ky.) Jovian League has been scheduled for Feb. 22, and a rejuvenation has been announced for March 17.

New York Jovian League.—Edward James Cattell, statistician of the city of Philadelphia, spoke on the "Great Future of This Country" at the New York Jovian League luncheon Feb. 16.

Jovian Chapter, Cleveland Electrical League.—Dr. Torrence Stuchell addressed the Feb. 17 noonday meeting of the Jovian chapter of the Electrical League of Cleveland on the subject "The New America."

Pittsfield Section, A. I. E. E. — The eighth lecture in the educational series of the Pittsfield Section of the American Institute of Electrical Engineers was held on Feb. 3. T. A. Worcester spoke on "Distributing Lines" and W. P. White on "Distributing Transformers."

Lehigh Valley Company Section, N. E. L. A.—On Feb. 1 Robert C. Bornblaser spoke at the regular monthly meeting of the Lehigh Valley Light & Power Company's section of the National Electric Light Association on "Line Distribution and Construction of an Electric Central Station."

Officers of American Institute of Consulting Engineers.—At the council meeting of the American Institute of Consulting Engineers held in New York Feb. 2 the following officers were unanimously elected: President, Dr. Elmer L. Corthell; vice-president, George Gibbs; secretary and treasurer, F. A. Molitor.

Lynn Section, A. I. E. E.—Howard W. DuBois of Philadelphia delivered a lecture on "Ore-Milling Oil Methods in Alaska" before the Lynn Section of the American Institute of Electrical Engineers on Feb. 7. The lecture was devoted to an explanation of the process of extracting copper and zinc from the ore by the flotation process.

Cleveland Electrical League.—Former Governor Myron T. Herrick of Ohio in an address before the Electrical League of Cleveland on Jan. 27 stated his belief that efficient organization in all American industries will be necessary if the United States is to maintain its high commercial standing after the close of the European war.

Schenectady Section, A. I. E. E.—The 169th meeting of the Schenectady Section of the American Institute of Electrical Engineers was held at the Union College Gymnasium on Feb. 10, when Dr. John A. Brashear, past-president of the American Society of Mechanical Engineers, spoke on "The Great Telescopes of the World and the Discoveries Made by Their Use."

Associations and Societies

A complete Directory of Electrical Associations is regularly printed in the first issue of each month on the next-to-last text page.

New York Section, E. V. A.—Joseph H. Tracy, assistant chief engineer of the Electric Storage Battery Company, will be the speaker at the meeting of the New York Section of the Electric Vehicle Association to be held on Feb. 23, in the Consolidated Gas Company's building. Mr. Tracy's subject will be "High-Rate Discharging and Charging of Lead-Acid Batteries."

Detroit-Ann Arbor Section, A. I. E. E.—A meeting of the Detroit-Ann Arbor Section of the American Institute of Electrical Engineers was held in Detroit on Feb. 11, when Ernest McCleary spoke on the 1915 National Electric Code. On March 10 E. Crossby of the Detroit Edison Company will give a paper on "The Electric Furnace."

Chicago Section, I. E. S.—A joint meeting of the Chicago Section, Illuminating Engineering Society, and the American Institute of Electrical Engineers will be held at the Western Society of Engineers' rooms, Monadnock Building, on Monday evening, Feb. 28, 1916. Papers on the subject of "Street Lighting" will be given. Fred Schwarze, electrical engineer for the Pfister & Vogel Leather Company, Milwaukee, spoke at the meeting on Feb. 10 on the subject "Factory Lighting."

N. E. L. A. Sub-committee on Electric Advertising. — A meeting of the sub-committee of the National Electric Light Association on electric advertising was held at the offices of the Toledo (Ohio) Railways & Light Company on Feb. 1, when it was decided to prepare a list of questions pertaining to the subject covered by this committee. The questions fall under the following heads: Roof signs, wall signs, billboards, outline, flood-lighting, store-front electric signs and outdoor store units.

Virginia State Electrical Contractors.—At the meeting of the Virginia State Electrical Contractors' Association held at Richmond, Va., on Feb. 7 the following officers were elected: President, W. B. Catlett, Richmond; vice-president, Ernest Meeks, Norfolk; secretary, E. M. Andrews, Richmond; treasurer, Irby Hudson, Lynchburg, and state director, W. R. Engleby, Roanoke. The association adopted the code of ethics passed by the national association in August, 1914, in regard to members' conduct in business relations toward one another. Following the meeting a banquet was tendered to the executive committee of the national body, then in session in Richmond. The next meeting of the State association will be held at Roanoke in August.

New Electrical Society in Seattle.—Representatives of the various companies engaged in the electrical industry in the city of Seattle have formed an organization for men interested and engaged in electrical development. The latest inventions and electrical appliances will be discussed at meetings of the organization, which will be held once a month. The following will serve as officers: President, William H. Byars of the Nepage-McKenny Company, Seattle; vice-president, A. M. Jones of J. A. Roebling's Sons, Seattle; secretary-treasurer, Roy Worth of the Pacific States Electric Company, Seattle. H. J. Gille, sales manager of the Puget Sound Traction, Light & Power Company, addressed the first meeting.

Rocky Mountain Municipal Electricians.—The Rocky Mountain Association of Municipal Electricians, including the States of Colorado, Wyoming, New Mexico and Utah, held its annual convention at the Albany Hotel, Denver, Col., on Jan. 20 and 21. There was a general discussion of standard electrical material and appliances and of important questions regarding municipal wiring. B. C. J. Wheatlake of the General Electric Company read a paper on wire and wiring appliances which aroused a large amount of discussion among the members, particularly in reference to the new code wiring. The following officers were elected: President, Lawrence Stone, city electrician of Denver; first vice-president, David Reed, superintendent of telegraph, Denver; second vice-president, G. L. Smith, city electrician, Fort Collins; secretary and treasurer, L. A. Barley, Rocky Mountain Fire Underwriters.

Association of Iron and Steel Electrical Engineers.—The monthly meeting of the Association of Iron & Steel Electrical Engineers is being held today at the Seventh Avenue Hotel, Pittsburgh, Pa., and is under the direction of the safety committee of the association. L. H. Burnett, assistant to the president of the Carnegie Steel Company, Pittsburgh, and L. R. Palmer of the State Department of Labor and Industry, Harrisburg, Pa., will address the meeting on the new "Pennsylvania State Compensation Act and Insurance Requirements." The schedule of future meetings is announced as follows: On March 18, under the direction of central-station power committee, Clark S. Lankton, chairman, the present state of purchased power in relation to steel-mill work will be discussed. On April 15, under the direction of the electrical development committee, Stewart C. Coey, chairman, the latest developments in new apparatus and appliances will be presented. On May 20, under the direction of the standardization committee, Frank D. Egan, chairman, changes to the present standardization rules and proposed rules will be taken up. On June 17, under the direction of the educational committee, Charles A. Menk, chairman, important work for the development of apprentices and assistants will be considered. The next annual convention will be held in Chicago, Ill., Sept. 18 to 22.

FINANCE, COMMERCE AND INDUSTRY

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Manufacturing and Industrial

A Sellers' Market

After a long period of inactivity, depression and lack of buying, the United States is again buying in a sellers' market. In the electrical industry this is especially true, as is borne out by the weekly trade articles that have been appearing in this section of the ELECTRICAL WORLD since the middle of December. The producer of goods is in absolute command of the present commercial situation.

All manufacturers, however, are not taking the same view of the situation. Some are not raising prices even though the raw materials are becoming more expensive every day, while others, and they are in the majority, are raising their prices. But at this time there is one thing that cannot be expected, and that is a decrease in prices. A sellers' market is never the time to cut prices. Nevertheless, manufacturers of large power apparatus as well as those turning out small accessories have been making the complaint of price cutting by competitors. It is felt that if the electrical industry is ever to remove the stigma of more than one price to the consumer the place to make the first start is with the first sale of the goods. The manufacturer, in other words, must take a firm stand in the question of his prices to the middleman.

This market, which began early in the fall of 1915, in some lines has passed the crest and is settling down to a normal basis; in some lines it is still gaining momentum, and in others it is now riding along on the crest. As it now stands, some manufacturers fear the market while others are rejoicing. Those who fear the present tendency point to a depression such as has followed other great wars when thousands of soldiers marched back from the fields of battle to seek employment. Wages were forced down, and in order to sell their goods manufacturers had to meet the wage earners' pocketbook until there was no longer an inducement to manufacture or to sell because of the narrow margin of profit. Industry then had to wait until the economic forces had established again an equilibrium. The producers who fear this market point out what they regard as the underlying features—the reasons for this condition of what they term pseudo-prosperity. The war, the size of which was probably never imagined, has produced unprecedented demands on the world's factories. These factories, the first to be affected, needed more machinery and thus affected other industries; they in turn needed huge quantities of raw materials. Before long almost everybody began to feel the effects of war orders, but it was the result of an abnormal trade, a destructive and not a constructive trade. Therefore, when these war orders cease, these men argue, we shall be worse off than before. We have dissipated billions of dollars of supplies and weakened to that extent our national resources. They point out that even the most peaceful-looking prosperity, if traced far enough, will be found to have its roots entwined about war orders.

On the other hand, those producers who view the situation with pleasure point out that even if all our prosperity is founded in war orders, which they will not admit as fact, when peace is declared our present prosperity will sink into insignificance with that to come. More than ever will America's factories and workmen, they say, be needed to rehabilitate Europe's devastated areas and industries. But, these men say, war orders are not the only reasons for prosperity in the United States. For two years or more the United States had been suffering from a depression, and buying had almost ceased. The result was low stocks on the part of the retailers, and as soon as money became easy enough these stocks were replenished. The demand for motors was conspicuously due to war orders, but the volume of buying in goods handled through middlemen has been due almost entirely to badly depleted merchant stocks. Still, if the merchant finds it financially practicable to buy it is a good indication that the consumer is making inquiries. Buildings are going up in greater number than in previous months, and this, it is stated, is the acid test of good times.

So quickly was the United States thrown into this industrial activity that few were prepared, and therefore it is not strange that different opinions are held and that there are different modes of attack. Nevertheless, it is still a sellers' market with two phases of a true sellers' market very much in evidence: first of all, deliveries are longer than usual, and, secondly, accounts have a closer scrutiny, with credits much shorter than they were in the preceding months.

Co-operation of Wire Manufacturers and Customers

In connection with the work of merging the Habirshaw Wire Company, the Electric Cable Company and the Waterbury Company into one concern under the name of the Habirshaw Electric Cable Company (noted in the ELECTRICAL WORLD of Feb. 5), Edwin W. Moore, 17 Battery Place, newly elected president of the latter-named organization, said:

"In taking over the Habirshaw and Waterbury plants we are adding to our equipment so as to extend the production facilities of the Electric Cable Company into central-station and submarine work. I have a notion that closer co-ordination between the central stations, equipment engineers and contractors could be cultivated by the wire manufacturer. The wire manufacturer undoubtedly furnishes the lines of communication from the point of generation to the point of use and for that reason is logically qualified to interpret the main business problems of transmitting electrical energy, provided he has an understanding of the requirements of all of the factors. I want to show how central stations, engineers, architects, owners and contractors are benefited by a wire manufacturer who is willing to do his full duty in meeting the requirements of these factors. The electrical industry has really become a big business. It is comparatively young and therefore more or less chaotic. I am in no sense a reformer, but it seems to me that if the industry is to meet adequately the enormously increasing demand for electrical equipment it is necessary for individual concerns to visualize the opportunity and make definite and practical plans extending beyond the mere production and delivery of their particular products. Two and one-half billion dollars is the approximate amount of money expended annually in this industry at the present time, and this is but a part of the business indicated by the growth we are now experiencing.

"The war has not affected the industry directly, but an economic by-product of the war has actuated industrial activity and building extension tremendously. For instance, the month of January, 1916, shows an increase of 130 per cent in building operations over the month of January, 1915. This means that practically every new building will have electrical equipment for lighting and power and, in the case of the residences, for many household utensils. One of the serious problems created by the war and increased demand is that of price. It is a very wise wire manufacturer who can estimate the increased cost of material and labor far enough in advance to protect his contracts for future deliveries. Copper for conductors, tin, lead, cotton for braid, chemicals for compounds, labor, machinery and tools have been advancing at the rate of 5 per cent a month, and the manufacturer must advance his resale prices. In doing this it is necessary to consider the problems of his customer. For instance, transportation companies are limited by law as to their income. Municipalities controlling public utilities

are constantly demanding extensions and improvements in service without any consideration for the increased cost of materials.

"When manufacturers of electrical equipment, such as insulated wire, are compelled to charge the transportation company a 20 per cent increase, that increased cost, added to the increased cost of labor, is directly deducted from the gross earnings of the transportation company. Some central stations furnish energy for light and power exclusive of transportation and are not directly controlled by law, but their problem of adding the increased cost to the ultimate consumer is a serious matter. That is why we, as manufacturers of insulated wire, are particularly concerned at this time about a better understanding of the industry and a practical use of that knowledge to define the production and cost until such time as the prices for electrical equipment can be adjusted on a fair and profitable basis to all concerned. So long as the war continues prices of materials are going to increase. I do not think that this business will slump immediately at the end of the war, because the waste of materials will have a permanent effect; but manufacturers who are earnestly interested in profits are going to have trouble in adjusting prices to meet conditions for from three to five years."

The Condit Electrical Manufacturing Company has moved its offices and factory from 283 Franklin Street to L and First Streets, South Boston, Mass.

The Northwestern Electric Company, Chicago, manufacturer of the Martin rotary converter, has established new offices at 1457 Broadway, New York.

The Ohio Brass Company, Mansfield, Ohio, has moved its New York office from the tenth floor to Room 1822, on the eighteenth floor of the Hudson Terminal Building, 30 Church Street.

Willard Doud, consulting civil, mechanical and electrical engineer, who formerly had offices at 538 South Dearborn Street, Chicago, has taken new quarters at 440 Old Colony Building.

The Terry Steam Turbine Company, Hartford, Conn., has moved its Chicago office from Room 524, Monadnock Building, to Room 403 in the same building. A. W. de Revere is sales manager of this office.

The B. J. Carney Company of Grinnell, Iowa, producer of Western cedar poles, has appointed Nelson P. Hall, manufacturers agent, Lytton Building, Chicago, as its Middle Western States representative.

Order for Splicing Sleeves.—The Montana Power Company, Butte, Mont., has ordered from Edwin G. Hatch, 120 Broadway, New York, a large number of seamless-copper splicing sleeves for its extensions.

R. E. McDuff, who has for several years been secretary of the Paragon Electric Company at Chicago, has resigned to take a position in the truck sales department of the Packard Motor Car Company at Detroit.

Dossert & Company.—The arrangement by which the Delta-Star Electric Company has been agent for Dossert & Company, 242 West Forty-first Street, New York, manufacturer of connectors, has been terminated.

The Electrochemical Company, Dayton, Ohio, manufacturer of electrolytic bleach equipments, has appointed the K. & B. Company, 25 North Seventh Street, Philadelphia, as its exclusive sales agent in the Philadelphia district.

H. O. Swoboda, Empire Building, Pittsburgh, Pa., has been retained as consulting engineer by the Humphrey Company of Kalamazoo, Mich., manufacturer of water heaters, to design a line of new types of electrically operated heaters.

The American Lighting Company, which manufactures flood-lighting equipment and which was formerly established at 617 West Jackson Boulevard, Chicago, has moved its factory to 1420 West Randolph Street, Chicago, and has increased its available floor space twofold.

F. E. McCall, who is secretary of the Chicago Section of the Electric Vehicle Association of America, has resigned as electric-vehicle engineer for the Commonwealth Edison Company to become city salesman for the Chicago office of the Philadelphia Storage Battery Company, with headquarters at 1621 Michigan Avenue.

J. R. Wilson, Ampere, N. J., has resigned his position as sales manager and second vice-president of the Crocker-Wheeler Company. Mr. Wilson has been associated with the Crocker-Wheeler Company for sixteen years, having been placed in charge of its sales operations in 1910.

New Addition for Campbell Electric Company.—The Campbell Electric Company, Lynn, Mass., is contemplating the erection of a six-story reinforced-concrete building, 50 ft. by 110 ft., on land adjacent to its present plant. The company reports that its business is just about double what it was a year ago, and the addition will be made to take care of this increase.

Steel Stampings Displace Aluminum in Hurley Vacuum Cleaners.—Owing to the enormous advance in the price of aluminum, the Hurley Machine Company of Chicago has substituted in its vacuum cleaners steel stampings for all parts formerly made of cast aluminum. The new type of cleaners are 1 lb. lighter besides being less expensive to make than those using aluminum. As a result of this development in the manufacture of cleaners, the company has reduced the price of its vacuum cleaners.

The Havens Electric Company, Albany, N. Y., was established Feb. 1, 1916, and has taken over the business and assets of the former Havens Electrical Supply Company. The status of the company remains the same and the personnel has been unchanged. The officers of the company are: Morton Havens, Jr., president; F. R. Meginniss, vice-president and general manager; E. Sornborger, secretary and treasurer; E. E. Brubaker, manager of fixture sales, and J. D. Haralson, manager of supply sales.

E. M. Smith has accepted a position as manager of the commercial lighting department and commercial engineer for L. Plaut & Company, manufacturers of "Alexalites" and other lighting fixtures, 434 East Twenty-third Street, New York City. Mr. Smith has also licensed the Plaut company to manufacture fixtures in United States and Canada under several of his patents. Until recently Mr. Smith was manager of the commercial lighting division of the Beardslee Chandelier Manufacturing Company at Chicago.

L. G. Shepard has been appointed sales manager of the Federal Sign System (Electric) of Chicago to succeed G. E. Fuller. Mr. Shepard was graduated from Cornell University in 1903 and since leaving school has been employed by the New York Shipbuilding Company, the Cherry River Boom & Lumber Company and the Federal Sign System (Electric). With the latter company, before being appointed sales manager, Mr. Shepard was first superintendent at the New York office, then superintendent of the Chicago factory, and then electrical engineer for the company.

Large Increase in Sales of Owen Magnetic Cars.—F. J. Titus, retail sales manager of the Baker R. & L. Company, Broadway and Fifty-seventh Street, New York, states that the sales of Owen magnetic cars in the past year increased 100 per cent over the number of sales closed in the previous twelve months. He also states that the sales for January this year exceed the sales of the same month of last year and that they have increased 300 per cent. All the cars have been sold, Mr. Titus remarked, without taking old cars in trade as part payment. In this respect, he declares, his company stands alone in New York trade circles.

The Spielman Electric Company, 1931 Broadway, New York, has appointed J. L. McKeever in charge of its sales and business organization. Mr. McKeever was formerly with the M. & M. Company of 1777 Broadway, New York, and previous to that was connected with the advertising department of the *New York World*. The company has also appointed R. M. Walsh mechanical manager, and he will have charge of the factory and the output of the Spielman company. Mr. Walsh was also formerly connected with the M. & M. Company. The Spielman Electric Company is a manufacturer of telephone devices, cigar lighters, flash-lamps, etc.

New Sales Agency in St. Louis, Mo.—L. M. Wood, who has been connected with the sales department of the Menominee Electric Manufacturing Company, Menominee, Mich., and James P. Lane, formerly of the Wesco Supply Company at St. Louis, have opened a manufacturers' agency at 915 Olive Street, St. Louis, Mo. The new agency is represent-

ing M. B. Austin & Company, the Davidson & Stevenson Porcelain Company, the De Veau Telephone Manufacturing Company, the Eastern Flexible Conduit Company, the Lowell Insulated Wire Company, the Nehring Insulated Wire & Manufacturing Company, the Peerless Electric Company, and the St. Louis Malleable Casting Company. The territory which the agency intends to cover includes the States of Missouri, Nebraska, Kansas, Oklahoma, Texas, Louisiana and Arkansas.

Machinery Hall Established in New York.—Manufacturers of machinery are to have a new help to trade expansion through the establishment of a permanent exhibition of machinery in operation for demonstration, to be styled Machinery Hall, on the fifth floor of the Grand Central Palace, New York. Spaces may be subdivided to suit the requirements of exhibitors in an area of 55,000 sq. ft., and exhibitors will be enabled to have their offices in the building, with electric lighting and all needed facilities. Besides the permanent exhibition, it is proposed to hold an annual American machinery exposition in which the permanent exhibitors in Machinery Hall will have an advantage over others in being already in the building.

New Fireproof Building for Battery Manufacturer.—The French Battery & Carbon Company, Madison, Wis., intends to move into its new fireproof building about March 15. The new plant is 175 ft. wide and 325 ft. long and is made of steel and brick. It will be equipped throughout with the latest types of electrically driven tools, the majority of which will be individually operated. Plans have been made for further addition within the year of another building of nearly equal size, although the present building will allow for an expansion of business of about 200 per cent. The building of the new factory has been necessitated not only on account of the company's increase in business but also because of a fire that completely destroyed the company's plant on Dec. 1. Within six days after the fire the company had resumed the manufacture of ignition dry cells and within ten days the manufacture of flashlamp batteries and cases. Notwithstanding the misfortune, J. C. Ford, sales manager for the French Battery & Carbon Company, states that the year 1915 was the most successful year the company has ever enjoyed and that it is noteworthy that the total business in December, 1915, showed a material increase over that of 1914, although the company had no factory the first ten days of the month. Mr. Ford declares that prospects for 1916 are exceedingly bright, one reason being the company's fortunate connection with one of the foremost electrochemical departments in the country. Through its chemical-research work the supply of raw material is assured, notwithstanding the general cutting off of imports of chemicals vital to battery manufacture and heretofore obtainable only in Europe. All prospects point to an exceptionally large business both in dry cells and flashlamp batteries, and Mr. Ford asserts that the company's arrangements have been made to take care of its share.

Electric-Supplies Industry in Japan Growing.—According to an article appearing in *Commercial Japan*, transmitted by Consul-General George H. Scidmore, stationed at Yokohama, Japan is no longer dependent upon foreign countries to supply its needs in electrical supplies. Efficient moderate-size motors and generators with ratings up to 100 hp. are being manufactured, it is reported, at moderate prices, and the small sizes of motors with ratings up to 10 hp. are being made in large quantities and comparatively cheap, the export prices comparing favorably with those of European make. Transformers are also turned out at low prices, but the iron sheets are in nearly all instances imported. In electrical conductors Japan is in a position to compete with the United States and Europe in quality and price, it is stated, as it is a large producer of copper and silk. With the exception of submarine telegraph cable, the former large imports of insulated conductors have entirely ceased. All classes of electric lighting and power cables, both rubber-insulated and paper-insulated, for high-tension or low-tension service, are being made to any specification. Porcelain insulators and porcelain ware and glassware for all purposes are largely being exported. Brass work, switches, lamp holders and cut-outs, although not quite so good as those of the best European design, are at low prices. Metallic-filament lamps are also being made in large quantities. Switchboards, instruments and meters are still being imported where high-class work is required, but for ordinary purposes the Japanese-made articles are said to meet the requirements at half the price of the imported goods. Various electrical accessories are now being manufactured by small Japanese factories. Electric fans, bells, batteries, etc., are often obtainable at prices lower than they can be produced in Western countries. The prospects for the electrical manufacturing industries in Japan are said to be good, but the foreign buyers must bear in mind that the reputation of the Japanese manufacturer is not yet established and that, therefore, it would be best for them to carry on their business through reliable agents only.

Copper Touches Highest Price in Forty Years.—Attention is called by the *Engineering and Mining Journal* to the fact that copper prices are now higher than they have been in forty years. In its current issue the *Journal* says: "During the last week the price for copper rose to a higher figure than anything on record in recent history, and by recent history we mean to go back to the time of our civil war and the years immediately following. In July, 1864, the average price for Lake copper at New York was 59¾ cents per pound, and the average for the year 1864 was 46¼ cents. By May, 1870, the price had fallen to 19 cents, but in April, 1872, it was up again to 41¼ cents. These prices were made, however, in a period of depreciated currency and are not properly comparable with prices quoted subsequent to the resumption of specie payments in 1879. In 1873 the average price for copper was 29 cents per pound. After that it was never higher than 25 cents until March, 1907. In March, 1907, Lake copper touched 26 cents, and electrolytic 25½ cents. Higher figures are talked about and probably were realized, but they were premium prices for relatively small lots for special delivery and were not representative of the broad market. However, at 25½ cents to 26 cents some large sales were made. Yet those were but large sales relatively speaking. On the turnover movement of 1906-07 the great turnover occurred at lower levels. As the price for copper rose above 20 cents, the ability of producers to make sales rapidly diminished. After the climax in price had been attained the market fell away rapidly. The situation in February, 1915, just nine years after the previous great boom in copper, is totally different. The price for copper is not only strong and rising but also producers are still able to sell all they can deliver. Whatever trouble there is at present is not inability of the producers to sell copper freely, but rather is it their inability to supply it at all."

Noteworthy Orders for Electrical Equipment for Steel Mill and for Large Turbines.—Closely following the recent order received by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., for the equipment of the Inland Steel Company, said to be the largest order for electrical equipment ever placed by a steel company, and noted in the ELECTRICAL WORLD of Jan. 22, the Westinghouse company announces the receipt of an order from the Phillips Sheet & Tin Plate Company, Weirton, W. Va. The contract calls for the complete electrical equipment of a new mill now in the process of erection by the Phillips company, which is engaged in the manufacture of sheet and tin plate, and produces cold rolled strips. This company a little more than a year ago commenced equipping its mill with electric drive, and when the decision was made to erect a new mill this form of motive power was decided on. The contract calls for two 3000-kw., three-phase, sixty-cycle, 6600-volt turbo-alternators, one 1500-hp. constant-speed alternating-current motor, one 2500-hp. adjustable-speed motor, and one 800-hp. adjustable-speed motor. The speed adjustment of about 50 per cent from high speed is obtained on the 2500-hp. and 800-hp. motors by means of direct-current synchronous control, a novel scheme devised and advocated by the Westinghouse engineers. The Westinghouse Electric & Manufacturing Company has also recently received a number of orders for turbines of large capacity, among which are the following: The Commonwealth Edison Company of Chicago for installation in its Northwest power house, Roscoe Street and California Avenue, Chicago, a three-phase, sixty-cycle, 12,000-volt tandem-compound turbo-generator rated at 30,000 kw., consist-

ing of a high-pressure turbine, a low-pressure turbine and one generator, all in tandem on one shaft, operating at a speed of 1200 r.p.m. and designed to carry a momentary overload of 35,000 kw. (the turbine will be served by two Westinghouse 28,000-sq. ft. surface condensers which are designed to maintain, with full load on the unit, a vacuum of from 28.5 in. to 29 in.); the Duquesne Light Company of Pittsburgh, for installation in its Brunots Island power house, a three-phase, sixty-cycle, 12,000-volt cross-compound turbo-generator rated at 40,000 kw., consisting of a high-pressure and a low-pressure turbine driving separate generators which operate in parallel. The speed of the high-pressure element of the latter-named set is 1800 r.p.m. and that of the low-pressure side 1200 r.p.m. This unit is capable of carrying momentary overloads of 46,000 kw. It will be served by two Westinghouse surface condensers, which will maintain, with full load on the unit, a vacuum of 28.5 in. to 29 in.

NEW YORK METAL MARKET PRICES

	Feb. 8 Selling Prices Bid	Asked	Feb. 15 Selling Prices Bid	Asked
Copper	£ s d		£ s d	
London, standard spot	101 10 0		106 10 0	
Prime Lake	26.50	to 27.50†	28.00	to 28.50
Electrolytic	26.50	to 27.50†	28.00	to 28.50
Casting	25.00	to 25.50†	26.50	to 27.00
Copper wire base	27.75	to 28.25†	29.25	to 29.75
Lead	6.10		6.25	
Nickel	45.00	to 50.00	45.00	to 50.00
Sheet zinc, f.o.b. smelter	24.00†		24.00	
Spelter	19.17½	to 19.42½	20.42½	to 20.92½†
Tin, Straits	41.25		42.25	
Aluminum, 98 to 99 per cent	52.00	to 54.00	54.00	to 58.00

OLD METALS

Heavy copper and wire	20.00	to 21.00†	21.00	to 23.00†
Brass, heavy	13.50	to 14.00†	14.00	to 14.50†
Brass, light	11.00	to 11.25†	11.50	to 12.00†
Lead, heavy	5.00	to 5.25†	5.00	to 5.25
Zinc, scrap	13.25	to 13.50†	13.50	to 14.00

COPPER EXPORTS

Total tons to Feb. 15	7,595

†Nominal.

Corporate and Financial

Cleveland (Ohio) Electric Illuminating Company.—The company's earnings for 1915, as shown by the annual report, were equivalent to 11.4 per cent on its $9,763,500 common stock. The rate paid on the stock was 8 per cent. The increase in earnings for the year is considered moderate, as compared with 1914, and the amount left for dividends is a little less than for that year. One item in the report, "valuation and regulation reserve," is an amount set aside for paying for appraisals and other expenses connected with the contention between the city and the company on the new rate ordinance. On the value of its property as assessed for taxation the company in 1915 earned 7.99 per cent. The statement follows:

	1915	1914
Gross operating revenue	$4,392,579	$4,255,943
Operating expense	1,834,153	1,801,221
Taxes	356,941	332,805
Renewal, replacement, depreciation	539,257	425,594
Valuation and regulation reserve	61,971	75,000
Debt amortization	14,808	13,994
Employees' fund	72,000	60,000
Non-operating revenue	12,473	6,922
Net income	$1,525.920	$1,554,251
Interest	$362,383	$364,089
Dividends, preferred	48,000	48,000
Dividends, common	781,080	742,156
Profit and loss	$334,457	$400,005

Grafton (W. Va.) Light & Power Company.—Creditors of the Grafton Light & Power Company, the Grafton Traction Company and the Grafton Gas & Electric Company, the two latter having been recently combined to form the first, have filed a petition in the Circuit Court asking a receiver for the new company, which is capitalized at $600,000. The court is also asked to investigate the details of the consolidation, it being charged in the petition of the creditors that the merger was in fraud of their rights.

Kings County Electric Light & Power Company, Brooklyn, N. Y.—The annual report of the company and of the Edison Electric Illuminating Company of Brooklyn, all of whose stock is owned by the Kings County company, states that the year 1915 has been an exceptional one, beginning in the uncertain period of business depression following the outbreak of the European war and ending at a time of unusual prosperity. The gross business of the company, which during the early part of the year showed but a nominal increase over the corresponding period of 1914, showed for the last few months a progressive monthly increase averaging more than twice that of the earlier period. The policy established at the outbreak of the European war of effecting economies in operating and administration expenses wherever possible with first-class service was consistently followed. At the same time an energetic new-business campaign was pursued, and while residential and small business consumers were added in large numbers, unusual success was attained in securing big power users. Power contracts were secured during the year aggregating upward of 31,000 hp., including twenty-one installations of over 300 hp. each and thirty-eight private plants which were discontinued in favor of the company's service. It is pointed out, however, that of the new power business secured a considerable portion consists of additional orders given by existing customers. Notable among such additional installations are two requiring over 8000 hp. on account of special export business. Although a 22,000-kw. turbo-generator was installed at the Gold Street station in 1914, the increase in the company's business has made it necessary to contract for a turbo-generator having a capacity of 30,000 kw. for installation during the coming summer. In view of conditions existing at the close of the year, the outlook for 1916 is promising. The comparative combined earnings of the two companies for 1915 and 1914 follow:

	1915	1914
Gross operating revenue	$6,928,115	$6,244,385
Operating revenue deductions:		
Operating expenses	$2,821,066	†$2,591,412
Depreciation charges	1,278,246	974,497
Taxes	470,218	441,691
Total	$4,569,530	$4,007,600
Net operating revenue	$2,358,585	$2,236,785
Net non-operating revenue	72,700	72,504
Gross income	$2,431,285	$2,309,289
Income deductions:		
Interest on funded debt	$791,175	$801,783
Interest on unfunded debt	52,340	42,404
Bond discount written off	20,269	20,268
Total	$863,784	$864,455
Net income	$1,567,501	$1,444,834
Dividends	$1,072,270	$1,057,228
Payment to Edison investment fund in accordance with employees' profit-sharing plan	78,468	66,596
Appropriations and adjustments previous years	*521	7,221
Total	$1,150,217	$1,131,045
Balance to credit of profit and loss	$417,284	$313,789
Previous profit and loss balance	2,180,156	1,886,368
Total profit and loss balance	$2,597,440	$2,180,157

*Decrease. †Adjusted for items amounting to $160,252 which were charged last year to expenses, but have been during 1915 transferred to construction on request of Public Service Commission.

Northern California Power Company, Consolidated, San Francisco, Cal.—The California Railroad Commission has authorized the company to enter into an agreement with the holders of its $670,000 Series A debentures dated Feb. 1, 1912, or more than three-fourths of the holders, providing a postponement of the maturing of these debentures from Feb. 1, 1916 to Feb. 1, 1920. The bonds are to bear interest at 6 per cent, and the power company shall pay monthly $5,000 on account of principal.

Seneca Power Corporation, Seneca Falls, N. Y.—Electrical corporations of central New York have applied to the Public Service Commission for the Second District of New York for approval of the financial arrangements for one of the largest hydroelectrical developments in the State. It is proposed to build a plant at Seneca Falls to furnish energy to the Central New York Gas & Electric Company and the Empire Gas & Electric Company, serving Wayne, Ontario, Seneca and adjoining counties. The Seneca Power

Corporation, which will do the actual work of installing this new station, asks to increase its capital stock from $5,000 to $1,600,000 and to issue the $450,000 of bonds. When the plant is completed it will be leased to the Central New York Gas & Electric Company, the lease being guaranteed by the Empire Coke Company, which owns both of the distributing companies that are to take the new power. Much of the money raised from this issue of capital securities will have to be paid for the real estate and water rights which are to be used for the undertaking.

Southern Sierras Power Company, Denver, Col.—The California Railroad Commission has authorized the company to issue $150,000 of its first mortgage 6 per cent twenty-five-year bonds. A year ago the commission gave the company authority to issue $300,000 of these bonds. In August the company reported that it had sold one-half of this amount and asked permission to sell $150,000 worth of first and refunding 6 per cent fifty-year bonds in lieu of the remaining $150,000 of the first issue. The present order is the result of a recent request for authority to sell $150,000 worth either of first and refunding bonds or of first mortgage bonds.

Texas Power & Light Company, Dallas, Tex.—Of the total gross earnings of the company for the twelve months ended Oct. 31, 1915, $1,562,876, or 91 per cent, was derived from light and power, the remainder being from gas. The earnings statement for the twelve months ended Oct. 31, 1915, follows:

	1915	1914
Gross earnings	$1,716,243	$1,577,383
Expenses and taxes	1,057,413	1,023,744
Net earnings	$658,830	$553,639
Interest charges	307,701	245,524
Income after charges	$351,129	$308,115
Dividends on preferred stock	128,033	111,381
Dividends on second preferred stock	69,750	23,425
Balance	$153,346	$173,309

Utah Securities Corporation, New York, N. Y.—The New York Stock Exchange has admitted to list $15,707,500 voting-trust certificates for capital stock, with authority to add when issued $15,067,600 additional.

New Utility and Industrial Companies

The Shirley Light, Heat & Power Company of Mount Union, Pa., has been chartered with a capital stock of $5,000 by John E. Zimmerman, Robert C. Shields and B. Marx, all of Philadelphia, Pa.

The Rock Hill Light, Heat & Power Company of Mount Union, Pa., has been incorporated by John E. Zimmerman, Robert C. Shields and B. Marx, all of Philadelphia, Pa. The company is capitalized at $5,000.

L. R. Reddinger & Company of Logansport, Ind., have been incorporated with a capital stock of $5,000 to deal in electrical supplies. Asa Carter, for many years chief city electrician, will resign to become affiliated with the company.

The Rieken Electric Company of Chicago, Ill., has been incorporated by E. H. Rieken, William Fischoff and Daniel A. Brennan. The company is capitalized at $2,000 and will manufacture and deal in mechanical and electrical devices.

The Loop Electric Company of Chicago, Ill., has been chartered with a capital stock of $20,000 to manufacture and deal in electrical appliances and fixtures. The incorporators are George J. Bumgardner, K. Bumgardner and H. Heap.

The Home Electric Company of New Franklin, Mo., has been incorporated with a capital stock of $10,000 for the purpose of purchasing and operating the electric-light plant in New Franklin. The incorporators are J. H. Keist, W. W. Carpenter and R. J. Carpenter.

The Electric Purifying Machine Company of Cleveland, Ohio, has been incorporated with a capital stock of $10,000 to deal in electrical, mechanical and chemical machinery. The incorporators are Fred Desberg, J. M. Goldman, M. A. McCormick, S. I. Powell and C. S. Stevens.

The Athens General Contracting Company of New York, N. Y., has been incorporated with a capital stock of $5,000 to do general contracting and electrical work. The incorporators are J. Wollison, A. Joseph and A. Galatis, 142 West 137th Street, New York, N. Y.

The American Electric Products Company of New York, N. Y., has been incorporated by M. E. Kaplan, A. L. Ohse and J. E. Mautner, 221 Sherman Avenue, New York, N. Y. The company is capitalized at $50,000 and intends to do a general engineering and contracting business.

The Modern Power Appliance Company of Rockford, Ill., has been chartered with a capital stock of $5,000 to manufacture and deal in equipment for isolated electric-lighting plants and accessories therefor. The incorporators are S. G. Smith, H. H. Rogers and William D. Knight.

The Safety Service & Engineering Company of Cleveland, Ohio, has been incorporated by Oscar McNab, E. M. Abramson, W. R. Englehart, E. C. Conrad and R. O. Bartholomew. The company is capitalized at $10,000 to do a general safety and efficiency engineering business.

The Chelsea Lighting Fixtures Works, Inc., of New York, N. Y., has been granted a charter with a capital stock of $10,000 to manufacture and deal in electric fixtures, chandeliers, etc. The incorporators are G. H. Epstein, N. Lipsky and M. P. Hoffman, 4 West Twenty-ninth Street, New York, N. Y.

The Eastern Development Company of Portland, Me., has filed articles of incorporation with a capital stock of $1,000,000 for the purpose of carrying on general electrical industrial enterprises. The officers are: John H. Pierce, president; David W. Snow, clerk, and Stuart O. Symonds, treasurer.

Trade Publications

Toy Motors.—The C. D. Wood Electric Company, New York, has issued a leaflet which describes and illustrates its "Monocoil" toy motor.

Switches and Appliances.—The Hart Manufacturing Company, Hartford, Conn., has just issued a revised price list of its "Diamond H" switches and appliances.

Copper History.—The Rome Wire Company, Rome, N. Y., is sending out a leaflet entitled "Copper History as Told in Prices," which gives the monthly average of prices of copper from 1885 to 1916.

Direct-Current Electric Motors and Generators.—Bulletin No. 217, brought out by the B. F. Sturtevant Company, Hyde Park, Boston, Mass., describes and illustrates the Type D direct-current motors and generators.

Farm Lighting and Power Plants.—The Strong Electric Company of Des Moines, Iowa, has issued a twenty-four-page illustrated catalog describing its automatic gasoline-electric power plants with storage-battery auxiliaries.

Electric Water Heater.—Ferranti, Limited, Central House, Kingsway, London, W. C., England, has prepared a leaflet, designated as List Hb-145, which describes and illustrates its heating attachment for use in connection with water tanks.

Tungsten Projector Lamps.—The Edison & Swan United Electric Light Company, Ltd., Ponders End, Middlesex, England, has prepared an illustrated bulletin, designated as Leaflet No. L-3124, on its "Pointolite" lamp, which is adapted especially for projector service.

Flood-Lighting Units.—The American Lighting Company, 617 West Jackson Boulevard, Chicago, Ill., is sending out an illustrated leaflet which contains illustrations of installations of its flood-lighting units and a reprint of an article which appeared in the *Electrical Review and Western Electrician* entitled, "The Sunlight Projector for Flood Lighting."

Lighting Control.—A. P. Lundberg & Sons, 477 Liverpool Road, London N., England, have recently issued the fourth edition of a neat and convenient 146-page pocket booklet entitled "Lektrik Lighting Connections," which is selling at sixpence. The booklet contains much useful information on various kinds of lighting connections, switches and control apparatus.

New England

ASHUELOT, N. H.—The Ashuelot Gas & El. Co. has applied to the Public Service Commission for permission to issue $60,000 in capital stock and $40,000 in bonds.

FRANKLIN, MASS.—The Union Lt. & Pwr. Co., Franklin, which supplies electrical energy in North Attleboro, Franklin, Wrentham and Foxboro, will erect a duplicate electric transmission line, to start from Pawtucket and pass through Adamsdale and Hillside.

HAMPDEN, MASS.—The town has voted to install an electric street-lighting system consisting of 50 lamps. The service, it is understood, will be furnished by the Central Massachusetts El. Co., Palmer. H. M. Parsons, Palmer, is general manager of the electric-light company.

HOLYOKE, MASS.—Bids will be received by John J. Kirkpatrick, manager of the gas and electric department, Holyoke, until Feb. 23 for furnishing two-wire, 110-volt meters, three-wire, 220-volt meters and three-phase, 550-volt power meters to the electric station for the current year.

WEBSTER, MASS.—Preparations are being made by the Webster & Southbridge Gas & El. Co. for the installation of a 3000-kw. turbo-generator set, for which bids have been asked.

WOODS HOLE, MASS.—Bids will be received by the commissioner of fisheries, Department of Commerce, Washington, D. C., until March 10 for furnishing and installing electric wiring and fixtures at the fisheries station, Woods Hole. Blank proposals, specifications, etc., may be obtained at the above office.

WORCESTER, MASS.—The Connecticut River Transmission Co., Bradley Building, Worcester, it is reported, is contemplating the development of the Connecticut River along the famous Fifteen Mile Falls in New Hampshire. The original plans contemplated an expenditure of $6,000,000 and provided for the construction of three dams, the first across the river at Monroe, 160 ft. high, at a cost of $2,000,000; the second at Waterford, 100 ft. high, and the third at the head of the Fifteen Mile Falls, near North Littleton, 80 ft. high. The company plans to supply electricity as far north as Groveton, and in Littleton, Lisbon, St. Johnsbury and other towns. Henry I. Harriman, Boston, is president.

NEW BRITAIN, CONN.—Plans are being considered by the Board of Public Works for the installation of an ornamental lighting system in the business section which provide for the erection of 83 arc lamps and would require an addition of $6,000 per year to the lighting appropriation. The United El. Lt. & Wtr. Co. furnishes the street-lighting service.

Middle Atlantic

BROOKLYN, N. Y.—Bids will be received by L. H. Pounds, president of borough of Brooklyn, Borough Hall, Brooklyn, until Feb. 25 for furnishing labor and materials for general construction, including electric work, for alterations of the premises known as the Williamsburg Trust Company Building, on South Fifth Street, between Driggs Avenue and Roebling Street. Bids will also be received at the same time for plumbing and gas-fitting work and for heating and ventilating work. Blank forms and further information may be obtained at the Bureau of Public Buildings and Offices, 50 Court Street, Brooklyn.

NORTH COLLINS, N. Y.—Bids will be received by the Board of Trustees, North Collins, until Feb. 23 for furnishing materials and constructing a water-works system for the village. The plans provide for about 6 miles of 8-in., 6-in. and 4-in. cast-iron water mains, 50 fire hydrants, 48 gate valves and boxes, two triplex power pumps and two gas engines, pumping station and well, steel standpipe, etc. Plans may be seen and specifications obtained at the office of the village clerk, North Collins, and at the office of the J. F. Witmer Co., engineer, Dun Building, Buffalo, N. Y.

SENECA FALLS, N. Y.—Application has been made to the Public Service Commission by the Seneca Pwr. Corpn., Seneca Falls, recently organized, for permission to increase its capital stock from $5,000 to $1,600,000 and to issue $450,000 in bonds. The company proposes to build a hydroelectric power plant at Seneca Falls to supply energy to the Central New York El. Co. and the Empire Gas & El. Co., both of Geneva, which serve cities and villages of Wayne, Ontario, Seneca and adjoining counties. The plant when completed will be leased to the Central New York Gas & El. Co., the lease to be guaranteed by the Empire Coke Co., which owns both of the distributing companies.

SILVER CREEK, N. Y.—The People's El. Lt. & Pwr. Co., Silver Creek, will submit a proposal to the taxpayers offering to light the streets of the town The company proposes to install incandescent series burning lamps. O. F. Kiefer is vice-president and manager.

SILVER SPRINGS, N. Y.—The municipal electric-light plant is being connected to the high-tension transmission line of the Perry (N. Y.) El. Lt. Co. for the purpose of establishing a 24-hour-day service in Silver Springs. J. E. Nash is president of the village.

SYRACUSE, N. Y.—Plans are being prepared by the Bureau of Gas and Electricity for the installation of an ornamental lighting system in Onondaga Park, under the direction of Prof. A. R. Acheson.

SYRACUSE, N. Y.—Line extensions are now being made by the Oswego River Pwr. Trans. Co., Syracuse, to the hamlets of Pennellville, Lamsons, Little Utica, Jacksonville, Lysander and Plainville, the first being in Oswego County and the others in Onondaga County. Service will be given at 110/220 volts, 25 cycles, single-phase. All material has been purchased. S. B. Storer is president.

WEST WINFIELD, N. Y.—The West Winfield El. Co. is contemplating the installation of a small water turbine or a good second-hand generating unit to be used as an auxiliary. C. Senif is proprietor.

ALLENTOWN, PA.—Bids will be received by the board of education, Allentown, until Feb. 29 for the complete electrical work for the Mosse School building. T. P. Wenner is secretary of board; Runyon & Carey, 845 Broad Street, Newark, N. J., are engineers, and Ruhe & Lange, Allentown, are architects.

CHRISTIANA, PA.—Plans are being considered for the construction of a new silk mill in Christiana, to cost abqut $50,000. The proposed mill will be operated entirely by electricity. For further information address the Business Men's Association of Christiana.

ELLWOOD CITY, PA.—Right-of-way has practically been secured by the Mahoning & Shenango Valley Ry. & Lt. Co., Youngstown, Ohio, for the erection of a high-tension transmission line from Lowellville to Ellwood City via New Castle. The plans provide for the erection of pyramid steel towers, 60 ft. high and 500 ft. apart, over the entire distance.

MOUNT CARMEL, PA.—The Edison El. Ilg. Co., Mount Carmel, expects to purchase 4 miles of No. 0 wire for transmission lines, 24 pole-type lightning arresters, six 7½-kw. transformers, and line hardware. A commercial department has just been organized by the company with H. Andrews in charge. S. S. Watkins is assistant superintendent.

PITTSBURGH, PA.—The Public Service Commission has recently approved charters granted to the South Beaver, Little Beaver, Coverdale, New Galilee, Cannelton, Big Beaver and Darlington El. Co.'s in Beaver and Lawrence Counties.

POTTSTOWN, PA.—The Philadelphia Suburban Gas & El. Co., Pottsville, is planning to install a 338-hp. horizontal water-tube boiler, contract for which has been placed with the E. Keeler Co., Williamsport. E. Brenner is division manager.

WASHINGTON, PA.—Plans are being considered by B. E. Coupler, manager of the Casino Theater; William Dunn, manager of the Bijou Theater, and H. Allen Brandon, manager of the Strand Theater, for the installation of an electric power plant to supply electricity to the three theaters and possibly other business houses in the block bounded by Chestnut, Main and Pine Streets, West, on a co-operative basis. The proposed plant will be installed in the basement of the Strand Theater.

WILSON, PA.—The installation of an electric-lighting system in Wilson is under consideration. Estimates have been submitted to the commissioners on the cost of installing a plant.

HIGHTSTOWN, N. J.—The El. Lt. & Pwr. Co., Hightstown, is negotiating with the Public Service El. Co. for the purchase of energy from the Trenton plant. Energy will be delivered at 13,200 volts, three-phase. The local company will purchase (and is open for bids) 150 kw. in transformers, 13,200 volts, and 26,400/2400 volts, together with switchboard and all necessary appliances. When improvements are completed the company will establish a 24-hour service. Thomas J. Duncan is vice-president and superintendent.

HOBOKEN, N. J.—Bids will be received by the Board of Commissioners of the city of Hoboken, City Hall, Hoboken, until Feb. 23 for furnishing and installing all necessary equipment, maintenance and supplying electricity for lighting the public streets, parks, places, public buildings, offices and structures of the city of Hoboken, in accordance with specifications No. 1; also for the same service in accordance with specifications No. 2, and for lighting the streets and other public places in the city of Hoboken in accordance with specifications No. 3. Specifications may be obtained on application to Daniel A. Haggerty, city clerk.

FREDERICK, MD.—Application has been made by the city of Frederick to the Public Service Commission for permission to install an electric-light plant for the purpose of illuminating the city and to furnish electricity for residential lighting.

MARTINSBURG, W. VA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Feb. 29 for installation complete of an electric elevator in the United States post office and court house at Martinsburg, W. Va.

LYNCHBURG, VA.—Bids will be received by the joint council committee on streets and sewers at the office of the city engineer, Lynchburg, until March 6, for improvement of Main Street, including construction of an underground conduit system for electric wires, furnishing and laying sewer pipe and repaving the street. Plans can be seen and specifications and forms of proposals obtained at the office of H. L. Shaner, city engineer, Lynchburg.

QUANTICO, VA.—The Quantico Co. has purchased 2000 acres on the Rappahannock River on which it proposes to erect a steel plant with accompanying industrial facilities, including electric-lighting system, cottages, bank building, etc. Eldridge Jordan, Real Estate Trust Building, Washington, D. C., is manager.

WASHINGTON, D. C.—Bids will be received by the chairman of board of awards, Department of Agriculture, Washington, D. C., until Feb. 25 for the installation of a 70-gal. experimental still with condenser, boiler and superheater and other equipment, in accordance with plans and specifications which may be obtained on application to the office of public roads and rural engineering, 515 Fourteenth Street. N. W., Washington. D. F. Houston is Secretary of Agriculture.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Boston, Mass., Schedule 9309—12 water-tube boilers. Brooklyn, N. Y., Schedule 9301—392 glasses for airport and deck lamps; Schedule 9294—2850 lb. brass pipe; Schedule 9295—one gaging system; Schedule 9302—600 ft. phosphor bronze chain. Philadelphia, Pa., Schedule 9293—installation of one dumbwaiter. Mare Island, Cal., Schedule 9305—miscellaneous standard pipe, miscellaneous squirt cans and brass oil feeders; Schedule 9298—three pneumatic motor hoists, 4000 lb.; Schedule 9310—six steam, cargo-hoisting winches. Newport, R. I., Schedule 9323—15,000 lb. brass tubing, miscellaneous copper tubing; Schedule 9322—500 lb. clear sheets uncut mica, 15,000 ft. ebonite tubing. Brooklyn, N. Y., Schedule 9318—150,000 ft. flexible double-conductor, 280,000 ft. bell wire, 45,000 ft. telephone cable; Schedule 9314—electric bench grinders. Applications for proposals should designate the schedule by number.

WASHINGTON, D. C.—Foreign trade opportunities are announced by the Bureau of Commerce reports as follows: No. 20,017—An American consular officer in India reports that the director of an educational institution in his district desires to communicate with American manufacturers of textile machinery, chemical laboratory filters, chemicals and chemical apparatus, woodworking machinery, color machinery, engines, boilers, tools, printing and bleaching machinery. Catalogs and full information should be sent. No. 20,022—An American consular officer in Central America desires to receive quotations, f. o. b. steamer New Orleans, on a 3-kw. to 5-kw., 500-cycle wireless transmitter, complete with modern receiving set. The transmitter should be equipped with quenched or synchronous rotary spark-gap and capable of transmitting a distance of 250 miles. The power is to be furnished by a mining power plant. A 200-ft. mast will be furnished by the purchaser. Cost of installation should be included in quotations. No. 20,025—A man in Spain informs an American consular officer that he desires to represent, on a commission basis, American manufacturers and exporters of coal, chemicals, automobiles, street-railway cars, steel rails for steam and street railways, motorboats, etc.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

No. 20,042—An American consular officer in Spain reports that a man in his district desires to represent American manufacturers of machinery, etc. At present he has urgent orders for one steam boiler, one vertical steam engine, one three-phase alternator, one 80-hp., three-phase motor, two combination grinding and pulp machines, and one water-feed pump. Detailed information relative to this opportunity may be obtained on application to the bureau or its district offices. No. 20,065—A firm in East Africa informs an American consular officer that it desires to receive catalogs, prices and full information from American manufacturers of bicycles and accessories, electric pocket lamps, etc. No. 20,087—A commercial organization in the United States has transmitted an inquiry from a man in Mexico who desires to communicate with American manufacturers of machinery for making incandescent electric lamps. He also desires quotations on glass globes for lamps, caps, carbon filaments for incandescent lamps, and glass tubes in which the wire filament is placed. No. 20,092—One of the commercial attachés of the Department of Commerce in South America reports that a mining company in Bolivia is prepared to sell 60 per cent tungsten ores, f. a. s., Antofagasta, Chile. Correspondence is preferred in Spanish, but may be in English. No. 71,934—Consul Thomas W. Voetter writes from Antofagasta, Chile, under the date of Dec. 24, that he has been informed that a company will soon be organized to construct and operate a telephone system in Antofagasta and the nitrate and mining regions. The consul, in addition to the address of the one to whom correspondence should be directed in connection with the new company, sent a list of dealers in telephone supplies in Iquique and Antofagasta, copies of which may be obtained at the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., or its district offices. No. 20,095—A commercial agent of the bureau reports that a man in England desires to represent American manufacturers of light hardware and household electrical fixtures. No. 20,098—A firm in Canada informs an American consular officer that it desires to purchase an electric motor, 125 hp., 550 volts, direct current. No. 20,100—A man in Italy writes that he desires to receive quotations from American manufacturers of electrical supplies used in electric-light installations. Further information may be obtained on application to the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., or its district offices.

North Central

CLIO, MICH.—Bids will be received by B. S. Jennings, secretary school board of District No. 7, Clio, until Feb. 29 for wrecking old building, remodeling and building new high-school building. Bids will include general contract, heating and ventilating, plumbing and electric wiring.

DETROIT, MICH.—Extensions and improvements, it is reported, will be made to the power plant of the Packard Motor Car Co., Detroit, including the installation of new equipment.

DETROIT, MICH.—Contracts have been awarded by Norval Wardrop, architect, for construction of power-plant building to be erected at 1154 Gratiot Avenue for the Finck Overhall Mfg. Co.

GRAND LEDGE, MICH.—Plans are being prepared for the erection of a power station on Bridge Street (to cost about $7,000) by the Consumers' Pwr. Co., Jackson.

LUDINGTON, MICH.—The City Council has awarded the Stearns Ltg. & Pwr. Co. a ten-year contract for street lighting and an extension of its franchise to 1938, to be ratified by the voters. The contract for street lighting provides for replacing the arc lamps now in use with incandescent lamps.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioners of supplies, City Hall, Cleveland, Ohio, until Feb. 25 for transformers for the municipal electric light department. Specifications may be obtained upon application to the commissioner of light and heat division, 1443 East Third Street.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies, City Hall, Cleveland, until Feb. 23 for one steam-driven air compressor for the Division Avenue pumping station, Department of Public Utilities, Division of Water. Specifications may be obtained upon application to the office of the commissioner of water, 413 Superior Avenue, City Hall.

CLEVELAND, OHIO.—A resolution is being prepared to present to the City Council inquiring as to the feasibility of the Cleveland Ry. Co. purchasing a large portion of its energy from the municipal electric plant. The railway company now purchases a large amount of electricity from the Cleveland Illg. Co. under a long-term contract. It is also proposed to ask for a bond issue of $1,000,000 for the purpose of installing two additional 10,000-kw. generating units in the municipal plant.

COLUMBUS, OHIO.—The Public Utilities Commission has authorized the Columbus Ry., Lt. & Pwr. Co. to issue $225,000 in bonds. The larger part of the proceeds will be used for extensions this year.

HUNTSVILLE, OHIO.—The installation of an electric-lighting plant in Huntsville is under consideration. M. E. Gehman is reported interested in the project.

URBANA, OHIO.—The contract for installing the complete lighting equipment at Urbana University has been awarded to the Electric Shop. For the present the Urbana Lt. & Pwr. Co. will supply electrical service, but the university is contemplating installing its own power plant.

CRAB ORCHARD, KY.—A project to install an electric-lighting plant in Crab Orchard is being promoted by Morris Perkins and H. G. Skiles. A franchise will be offered for sale on March 7.

FLEMINGSBURG, KY.—Plans are being considered for changing the plant of the Flemingsburg Lt. & Ice Co. from a direct-current to an alternating-current system. D. Bankel, electrical engineer, Cincinnati, Ohio, has been engaged by the company to make investigations.

LONE OAK, KY.—S. M. Ware & Son, it is reported, contemplate the installation of a generator to supply electricity for lighting purposes in Lone Oak. Post office address, R. F. D. from Paducah.

PRINCETON, KY.—A franchise providing for the distribution and sale of electricity in Caldwell County will be offered for sale by the fiscal court in Princeton on Feb. 21.

LOOGOOTEE, IND.—The Loogootee El. Lt., Pwr. & Wtr. Co. is considering the installation of a storage battery for charging vehicles. Jesse Rutledge is secretary and manager.

SEYMOUR, IND.—The City Council has granted the Commercial El. & Pwr. Co. a franchise to install and operate an electric-lighting plant in Seymour.

ALTAMONT, ILL.—W. G. Scoggins, manager of the municipal electric-light plant, would like to correspond with parties having a good second-hand open-feed water heater of about 150 hp. for sale.

AURORA, ILL.—Improvements are contemplated to the municipal electric-light plant, including the installation of new boilers, two 300-kw. turbo-generator sets, stokers, switchboard, motor-driven pumps, steam piping, etc., also the erection of a transmission line to isolated wells. At an election to be held in April the proposal to issue $100,000 in bonds for the above improvements will be submitted to the voters. W. E. Barclay is city electrician.

BLOOMINGTON, ILL.—The Bloomington & Normal Ry. & Lt. Co., Bloomington, has been granted a certificate of convenience and necessity to erect a transmission line from Chenoa to Lexington.

BYRON, ILL.—The Byron El. Lt. & Pwr. Co. has applied for a certificate of convenience and necessity to construct and operate an electric-light plant in Byron.

CHESTER, ILL.—The installation of a motor and motor-driven centrifugal pump (having a capacity of about 400 gal. per minute) in the Chester light and ice plant is contemplated. J. Fred Gilster is president.

CHICAGO, ILL.—Estimates have been submitted to the Lincoln Park Commissioners for improvements to the lighting system in Lincoln Park, including the installation of a 500-kva. turbo-generator set, non-condensing turbine exhausting into heating system, power to be delivered to station bus; changing over several single-phase, 2300-volt lines to three-phase, four-wire, 2300/4000-volt lines and equipment; several series circuits being changed to multiple-conductor feeder cables. The installation of about 350 boulevard lamps of 400 cp., type "C," complete on circuits with armored cable laid in parkway, is also contemplated. The proposed work depends on funds available. Mentioned in the issue of Jan. 29. C. H. Shepherd is electrical engineer in charge.

DELAVAN, ILL.—The Royal Lt. & Pwr. Co., Delavan, expects to install a small generator and engine in its plant. W. H. Few is manager.

ELDORADO, ILL.—The Public Utilities Commission has granted the Saline El. Co. permission to issue $30,000 in bonds and $20,000 in capital stock for the purpose of taking over the property of the Eldorado Lt. & Pwr. Co. A certificate of necessity has also been granted the Saline company to establish a distributing system and to erect a transmission line from Eldorado to Ridgeway.

GALESBURG, ILL.—Extensive improvements, it is reported, are contemplated by the Galesburg Ry., Ltg. & Pwr. Co., involving an expenditure of $225,000. They will include extensions to the boiler plant, including new boilers, the installation of a new generating unit (for railway service) in the electric department, replacing gas pipes, sinking of a new well; also enlarging the heating plant and extensions to mains.

LINCOLN, ILL.—Bids will be received by the Board of Administration, Capitol Building, Springfield, until March 7 for the construction of a school building at the Lincoln State School and Colony. Separate bids to be submitted on general work, heating, electric wiring, and plumbing and sewers. Plans and specifications may be obtained upon application to James B. Dibelka, state architect, 130 North Fifth Avenue, Chicago.

NORRIS CITY, ILL.—Bonds to the amount of $100,000, it is reported, have been issued by the Ohio Valley El. Co., Marion, the proceeds to be used for extensions and improvements. The company is operating a power plant in Norris City and contemplates the installation of larger plants in the near future. F. W. Richard, Carterville, is president of the company, and F. H. Wyckes, Marion, is secretary.

STREATOR, ILL.—The contract for installing the ornamental lighting system on Main and Vermilion Streets has been awarded to J. W. Gates, Inc., at $10,144.

THE CARRIERS MILLS, ILL.—The Carriers Mills Utilities Co. will make some extensions to its transmission lines during the spring and summer. The company will soon establish an office for the display of lighting fixtures, cooking apparatus, vacuum cleaners, flashlamps and washing machines. W. E. Taborn is secretary and treasurer.

ANTIGO, WIS.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until March 14, for construction complete, including mechanical equipment and approaches, of the United States post office at Antigo, Wis.

RHINELANDER, WIS.—The capital stock of the Rhinelander Lt. & Pwr. Co. has been increased from $100,000 to $125,000, the proceeds to be used to enlarge the plant.

WEST ALLIS, WIS.—The installation of a municipal electric-lighting plant in West Allis is under consideration by the City Council.

ROCHESTER, MINN.—At an election held Jan. 25 a proposal to issue $360,000 in bonds for the construction of a hydroelectric power plant near Zumbro Falls was carried. A. T. Wright is city clerk.

ST. PETER, MINN.—The City Council is reported to have closed a contract with the Consumers' Pwr. Co., Mankato, to furnish electricity for street and commercial lighting and for power purposes in the city of St. Peter.

ALGONA, IOWA.—Improvements are contemplated to the municipal electric-light plant, including the installation of a new engine. The cost is estimated at about $18,000. J. W. Kelly is superintendent of municipal plant.

DES MOINES, IOWA.—The installation of an ornamental street-lighting system on Polk Boulevard is under consideration.

ONAWA, IOWA.—The Board of Supervisors has awarded a contract to Charles E. Churchill, Battle Creek, for erection of an electric transmission line from Castana to the county home, to cost about $800.

SIDNEY, IOWA.—The City Council is considering a proposal to grant to the Continental Gas & El. Corpn., Cleveland, Ohio, a franchise to install and operate an electric-light plant in Sidney.

HIGGINSVILLE, MO.—At an election held recently the proposal to issue $15,000 in bonds for improvements to the municipal electric-lighting plant was defeated.

WAVERLY, MO.—Application has been made by C. P. Landrum to the City Council for a franchise to install and operate an electric-lighting plant in Waverly.

WALLACE, S. D.—The Bradley El. Co. has been granted a franchise to extend its transmission lines to Wallace and to furnish electricity for lamps and motors in that city.

OMAHA, NEB.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until March 13 for the installation complete of an elevator, pump, etc., in the United States court house, custom house and post office at Omaha. For details see proposal columns.

BUHLER, KAN.—The Council is considering the installation of a municipal electric-lighting plant in Buhler.

DOWNS, KAN.—The Solomon Valley Pwr. Co. expects to install a new 250-kw. generating unit (directly connected) and a new boiler. The company also expects to extend its transmission lines to Cedar, Claudell and Harlan. D. D. McGuire is manager.

ELLINWOOD, KAN.—The city of Ellinwood is contemplating the purchase of an oil engine for the municipal lighting and water plant.

HIAWATHA, KAN.—The Hiawatha Lt., Pwr. & Ice Co. will install within a few weeks a 250-hp. Busch-Sulzer Diesel oil engine and a 200-kw. General Electric generator, directly connected. R. H. Love is secretary and superintendent.

INMAN, KAN.—The City Council is negotiating with the United Wtr., Gas & El. Co., Hutchinson, for the erection of a transmission line to Inman and supplying electricity for commercial purposes here.

PENALOSA, KAN.—The installation of a municipal electric-light plant in Penalosa is under consideration.

STAFFORD, KAN.—The city of Stafford is negotiating with the town of Sylvia to supply a 24-hour service. If the plans are carried out it will necessitate the installation of an additional generating unit in the municipal electric-light plant.

Southern States

BURLINGTON, N. C.—The Piedmont Ry. & El. Co., Burlington, has closed contracts with the Oneida Mills in Graham and with the Trolingwood Mills at Haw River to supply electricity to operate the two plants. Surveys are also being made by the company to erect a transmission line into Elon College and Gibsonville to supply electrical service to those towns. J. H. Bridgers is president.

NEWBERN, N. C.—Bids will be received by F. T. Patterson, city clerk, Newbern, until March 6 for sinking well, etc. Separate proposals will also be received at the same time for the finishing and installation of an electric-motor-driven or steam-driven pump.

CAMDEN, S. C.—Within the next six months the managers of the municipal electric-light plant expect to purchase 25 meters and 25 kw. in transformers. E. D. McCutcheon is superintendent of the municipal water and light plant.

IVA, S. C.—The installation of an electric-lighting system in Iva is under consideration. Electrical service may be obtained from the Southern Pub. Utilities Co., Charlotte, N. C.

ACWORTH, GA.—At an election to be held Feb. 15 the proposal to issue $5,000 in bonds for improvements to the municipal electric-light plant and water-works will be submitted to the voters.

ADEL, GA.—The town of Adel expects to install a 3-hp. motor-driven centrifugal pump, having a capacity of 50 gal. per minute, 20-ft. suction and 35-ft. head. T. R. Sutton is superintendent.

COLUMBUS, GA.—The Columbus Pwr. Co. expects to install within the next 12 months one bank of three 1333-kw., 13,200/66,000-volt step-up transformers in Goat Rock station; one 750-kw. motor-generator set and exciter for same in station No. 4 to furnish electricity for street-railway service; one 1000-kva. synchronous condenser for power-factor correction at Hogansville, Ga. J. S. Bleecker is manager.

FOLKSTON, GA.—The Chamber of Commerce has authorized B. F. Scott, president, to make investigations as to cost of an electric-light plant with sufficient output to maintain 500 lamps, etc.

DE LAND, FLA.—The De Land Lt., Pwr. & Ice Co., expects to build new cold-storage rooms, reinforced concrete and steel construction.

PLANT CITY, FLA.—The City Council is contemplating the purchase of the local electric plant or the construction of a new system.

BIRMINGHAM, ALA.—The installation of an electric-lighting plant in Idlewild Park to supply electricity to the south side of the city is reported to be under consideration by the City Commission. Julian Kendrick, city engineer, has been authorized to make investigations as to the feasibility of the project.

GADSDEN, ALA.—Two plans for the installation of a municipal electric-lighting system in Gadsden are under consideration; one is to install a generator at the municipal water-works station and the other to purchase energy from the Alabama Pwr. Co.

ARCADIA, LA.—The property of the North Louisiana Lt. & Pwr. Co., Arcadia, will be sold on Feb. 26. J. B. Herring is president

LANGSTON, OKLA.—The State Legislature has appropriated $16,268 for rebuilding the power station at Langston Colored College, which was destroyed by fire.

OKLAHOMA CITY, OKLA.—The installation of an ornamental street-lighting system in Oklahoma City is under consideration. The Oklahoma Gas & El. Co. furnishes the street-lighting service.

RINGLING, OKLA.—At an election to be held Feb. 25 the proposal to grant a franchise to the Southwestern Pub. Ser. Co., Ardmore, to construct and operate an electric-lighting plant and natural-gas system will be submitted to the voters.

WILSON (P. O. NEW WILSON), OKLA.—The town of Wilson has engaged the Benham Engineering Co., consulting engineer, Oklahoma City, to prepare plans for an electric-light plant and water-works system, to cost approximately $25,000. S. B. Brimer is president of the board of trustees.

AUSTIN, TEX.—Bids will be received by the Public Buildings and Grounds Department of Austin, until March 4, for one 200-hp., left-hand, side-crank engine, one 125-kw. generator (directly connected), switchboard and instruments.

BURNET, TEX.—Plans are being considered by the Marble Falls Wtr. & Pwr. Co. for extending its transmission line from Marble Falls to Burnet.

DUBLIN, TEX.—The Central Texas Pwr. & Trans. Co., Hico, contemplates the erection of a transmission line to Harbin. Henry Weiser, Dublin, is vice-president of the company.

HEREFORD, TEX.—The Hereford El. Lt. & Pwr. Co. expects to install new equipment in its plant next spring, including a 125-hp. return-tubular boiler and a 50-kw. steam-driven generating unit. F. H. Oberthier is proprietor.

HOUSTON, TEX.—The City Council has appropriated $17,800 for the installation of a bar-channel trolley system for the cotton sheds at Turning Basin by the Southwestern Mechanical Co.

SAN ANTONIO, TEX.—Plans are being prepared by the San Antonio Gas & El. Co. for increasing the output of its "B" plant on Conception Avenue by 5000 hp. at a cost of about $150,000. New equipment, including five new boilers and a steam turbine, will be installed.

Pacific States

ABERDEEN, WASH.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until March 22 for construction complete, including mechanical equipment and approaches, of the United States post office at Aberdeen.

ALBION, WASH.—The City Council has decided to install an ornamental street-lighting system covering the entire business section of the city.

EVERETT, WASH.—The City Council has passed a resolution authorizing the city clerk to make formal application at once to the United States Department of Agriculture for a preliminary power permit in the government reserve in the territory known as Sultan Canyon. Preliminary surveys for power sites, dams, etc., have been conducted in Sultan Canyon by the city of Everett. The city contemplates developing the power in connection with its proposed municipal electric plant.

MONTESANO, WASH.—The City Council is considering calling an election to submit to the voters the proposal to establish a municipal electric-light plant and water-works system in Montesano.

SEATTLE, WASH.—A campaign has begun by property owners and business men in the university district for the installation of cluster lamps on Fourteenth Avenue, N. E., from Thirty-fifth Street East to Cowan Park. Property owners on Lucille Street and Twelfth Avenue South in Georgetown, a suburb of Seattle, have petitioned the City Council for the installation of street lamps in that district.

SEATTLE, WASH.—The utilities committee of the City Council has recommended the appropriation of $2,000 to be expended in taking meter readings of the Sauk and Suiattle Rivers, with a view of investigating the possibilities of the Sauk Suiattle power site. J. D. Ross, superintendent of lighting, has informed the committee that in his opinion no fully developed site can be obtained and efforts must be directed to securing a site to be developed by the city.

SEATTLE, WASH.—In his annual report to the City Council, Mayor H. C. Gill recommends that the Council issue a call for bids for supplying electrical energy to the amount of 22,000 kw. for the municipal electric plant, the Council to reserve the right to purchase the generating plant of the successful bidder. He asks for the completion of the investigations of the potentialities of the Sauk-Suiattle power site, and also declares that a fireproof building for the Cedar Falls power plant is imperative. The additional power will be needed until the Cedar River masonry dam is available for use.

ASHLAND, ORE.—Arrangements have been made by the City Council whereby the city will install about 40 new street lamps. Electricity to maintain the lamps will be secured from the California-Oregon Pwr. Co.

EUGENE, ORE.—An ordinance providing for the installation of ornamental lamps on Willamette Street between Eleventh and Thirteenth Avenues has been passed by the City Council. The Council is also considering an ordinance calling for the installation of ornamental lamps on Seventh Avenue between Olive and High Streets and on Eighth Avenue East between Willamette and Pearl Streets.

LA GRANDE, ORE.—The Morgan Lake plant of the Eastern Oregon Lt. & Pwr. Co., La Grande, recently destroyed by fire, it is understood, will be rebuilt immediately.

PORTLAND, ORE.—Permission has been granted to business men and property owners on First Street, between Morrison and Yamhill Streets, for the installation of a cluster-lamp lighting system.

PORTLAND, ORE.—The contract for the installation of electrical power on the lift span for the Interstate Bridge, spanning the Columbia River, between Portland, Ore., and Vancouver, Wash., has been awarded to Ne Page, McKenna & Co., Portland and Seattle, Wash.

RUPERT, IDAHO—The Rupert El. Co. has purchased material for a series lighting circuit in the business section of the town, consisting of 13 lamps of 600 cp. on standards. F. N. Victor is manager.

ALAMOGORDO, N. M.—The installation of a municipal electric light and power plant and water-works system is under consideration by the City Board of Trustees.

CARLSBAD, N. M.—The Pub. Utilities Co., Carlsbad, contemplates the installation of new equipment in the local electric-light plant and water-works system, to cost about $10,000. A. J. Muzzy is president.

Canada

KASLO, B. C.—The city of Kaslo is planning to build a new dam on its present dam site on Kaslo Creek, increasing the head 10 ft. Part of the lighting load may be put on meter service this year. F. D. Emory is chief engineer.

AMHERSTBURG, ONT.—The Town Council has decided to secure electricity from the Hydro-Electric Power Commission of Ontario. A new street-lighting system, to cost $2,582, will soon be installed.

LONDON, ONT.—Three transformers and switchboards, it is understood, will be purchased by the Utilities Commission. The installation of an ornamental lighting system on Wellington Boulevard is under consideration. The Hydro Commissioners are contemplating the purchase of meters at a cost of about $12,000; also the erection of steel towers, wires and cables, involving an expenditure of about $24,000. E. V. Buchanan is electrical engineer.

OTTAWA, ONT.—Bids will be received by John B. McRae, consulting engineer, 310 Booth Building, Ottawa, Can., until March 1 as follows: (1) For construction of pumping station and electric substation on Lemieux Island, within the city boundary; (2) for furnishing and installing equipment as follows: (a) main piping, valves and specials; (b) heating and plumbing for the above station. Plans and specifications may be obtained at the office of the engineer.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer of the Panama Canal, Washington, D. C., until March 3 for furnishing staybolt iron, steel cable, steel or iron pipe, sheet copper, brass tubing, lead pipe, sheet lead, chain blocks, etc. Blanks and general information relating to this circular (No. 1015) may be obtained from the above office or from the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and Fort Mason, San Francisco, Cal.

1,170,545. Signaling Device for Apparatus for Stopping Vehicles; J. J. Keenan, New York, N. Y. App. filed May 14, 1915. For signaling street vehicles.

1,170,552. Means for Producing Alternating Current by Cathode-Ray Tubes; A. Meissner, Berlin, Germany. App. filed June 2, 1915. Relay simultaneously used as an energy transformer for the received oscillations.

1,170,557. Toy Telegraph Sounder; J. S. Newman, Cleveland, Ohio. App. filed Feb. 6, 1915. Made inexpensively to sell as a toy.

1,170,566. Panelboard; F. F. Skeel, Chicago, Ill. App. filed Sept. 22, 1911. For three-wire systems.

1,170,599. Pendent Switch; R. B. Benjamin, Chicago, Ill. App. filed Nov. 18, 1910. Constructed to be readily taken apart.

1,170,607. Electric Measuring Instrument for Iron-Loss Testing; L. W. Chubb, Wilkinsburg, Pa. App. filed May 24, 1909. Direct indication of the roof-mean-square value.

1,170,608. Method of and Means for Testing Electrical Apparatus; L. W. Chubb, Wilkinsburg, Pa. App. filed May 24, 1909. For determining iron or core losses.

1,170,613. Signaling System; G. Crosby, New York, N. Y. App. filed July 12, 1910. For elevators.

1,170,614. Apparatus for Regulating the Temperature of Fluids; H. Darwin and C. C. Mason, Cambridge, Eng. App. filed Aug. 14, 1911. Includes a power-operated valve.

1,170,618. Induction Motor; A. M. Dudley, Swissvale, Pa. App. filed Nov. 8, 1911. Adjustable speed construction.

1,170,620. Vapor Rectifier; S. W. Farnsworth, Pittsburgh, Pa. App. filed March 30, 1914. Containing receptacle absolutely impervious to passage of gas or vapor.

1,170,657. Alternating-Current Commutator Motor; F. W. Meyer, Wilkinsburg, Pa. App. filed Jan. 11, 1913. Speed and power factors can be separately regulated.

1,170,670. Electromagnetic Relay; E. A. Reinke, Rochester, N. Y. App. filed May 10, 1915. Sensitive and quick-acting; for telephone work.

1,170,680. Selective Wireless-Telegraph Apparatus; F. G. Sargent, Westford, Mass. App. filed Oct. 3, 1914. Dial and indicator construction.

1,170,681. Warp Stop Motion for Looms; A. H. Sawtell, Winthrop, Mass. App. filed March 29, 1915. For broad looms.

1,170,689. Rectifier Anode; E. F. Sipher, Wilkinsburg, Pa. App. filed June 9, 1914. Welded head with liquid seal covering joint.

1,170,723. Strain Insulator; C. N. Allerding, Mansfield, Ohio. App. filed March 2, 1914. One member has sides bendable over other member.

1,170,727. Apparatus for Regulating the Temperature of Furnaces and the Like; R. E. Baker, Cleveland, Ohio. App. filed Nov. 25, 1912. Maintains temperature of furnaces within predetermined limits.

1,170,728. Circuit Controller; T. E. Barnum, Milwaukee, Wis. App. filed May 11, 1914. Drum type; for washing machines.

1,170,738. Circuit Controller; H. H. Cutler and F. S. Wilhoit, Milwaukee, Wis. App. filed. Nov. 30, 1908. For controlling electrical magnetic variable-speed devices.

1,170,751. Rail Bond; A. B. Herrick, New York, N. Y. App. filed Nov. 29, 1912. Welded to rail ends.

1,170,796. Electromagnetic Telegraph Key; R. L. Boulter, Los Angeles, Cal. App. filed Nov. 13, 1914. Laboratory reed controlled by key.

1,170,811. Electrical Resistance; C. E. Hay, Ilford, and H. W. Sullivan, London, England. App. filed March 14, 1914. Particularly for wireless work.

1,170,819. Galvanic Cell; M. L. Kaplan, Brooklyn, N. Y. App. filed May 1, 1915. Depolarizer, consisting of discrete particles of graphite covered with higher oxide of manganese.

1,170,853. Signaling Apparatus; H. Shoemaker, Jersey City, N. J. App. filed Sept. 29, 1911. Improved spark-gap construction for wireless.

1,170,881. Wireless Receiving System; L. De Forest and C. Logwood, New York, N. Y. App. filed March 12, 1914. Selective audion, detector and amplifier.

1,170,882. Automatic Switching Device for Telephone Systems; L. De Forest, New York, N. Y. App. filed July 7, 1915. Automatic relay for wireless telegraphy.

Record of Electrical Patents

Notes on United States Patents issued Feb. 8, 1916, prepared by Mitchell & Allyn, 41 Park Row, New York.

1,170,909. Automatic Telephone System; D. S. Hulfish, Toronto, Canada. App. filed Oct. 16, 1911. Means for selecting idle switching device.

1,170,915. Method of Making Radiators; W. H. Legate, Hartford, Conn. App. filed May 27, 1915. Metal deposited on fusible grid-like cores.

1,170,920. Insulating Joint; L. McCarthy, Boston, Mass. App. filed June 1, 1914. Mica tube about flanged members with inclosing steel shell.

1,170,924. Master-Controlled System of Electric-Light Wire; I. L. Matson, Marshfield, Mass. App. filed Sept. 19, 1913. System by which lights in all rooms of building can be thrown on in case of burglarious entry.

1,170,943. Electric-Heating Element; H. O. Swoboda, Edgewood Borough, Pa. App. filed Aug. 16, 1915. Wires seated in grooves in insulating base.

1,170,959. Marine Lamp and Electric Connection; A. S. Campbell, Medford, Mass. App. filed June 14, 1910. Waterproof construction.

1,170,969. Means of Transmitting Intelligence; R. A. Fessenden, Brant Rock, Mass. App. filed Dec. 23, 1907. Wireless telegraphy.

1,170,974. System of Motor Control; S. H. Keefer, Plainfield, N. J. App. filed May 29, 1911. For reversing motors.

1,170,990. Inclosed - Switch Construction; C. D. Platt, Bridgeport, Conn. App. filed July 15, 1915. Switch can be locked open with box in closed position.

1,170,996. Retaining Mechanism; O. A. Ross and H. B. Taylor, Rochester, N. Y. App. filed May 3, 1915. For semaphore signals.

1,171,002. Electric Hand Lamp; G. A. Soehnlein, Brooklyn, N. Y. App. filed May 20, 1914. Lamp head attachable to dry cell.

1,171,021. Speedometer; A. A. Canton, New York, N. Y. App. filed May 25, 1914. Has a single movable element.

1,171,042. Alarm; J. J. Greytak, Great Falls, Mont. App. filed March 10, 1914. Operates when suitcase is lifted off floor or other support.

1,171,055. Engine Starting, Lighting and Ignition System; C. F. Kettering, Dayton, Ohio. App. filed April 17, 1911. Motor-generator system.

1,171,059. Resistance Unit for Electrical Apparatus; A. J. Loguin, Petrograd, Russia. App. filed April 3, 1915. Particularly for resistance boxes.

1,171,088. Alarm System for Fire Escapes; D. S. Burkhart, Spokane, Wash. App. filed March 5, 1915. Operates lights for fire escapes and sounds alarms.

1,171,095. Ultimate-Limit Stop for Elevators; A. M. Coyle, New York, N. Y. App. filed April 26, 1912. Operates to bring car to rest surely and safely at end of its travel. (Sixty-five claims.)

1,171,104. Electric Heater; H. W. Denhard, Milwaukee, Wis. App. filed Jan. 30, 1911. Point of flatiron is kept as hot as other parts.

1,171,126. Insulator Pin; J. G. S. Lindholm and A. P. Lindholm, Chicago, Ill. App. filed Nov. 2, 1914. Resilient sheet-metal cross-arm pin.

1,171,127. Metallic Cross-Arm Pin; J. G. S. Lindholm, Chicago, Ill. App. filed Nov. 19, 1914. Made of sheet metal.

1,171,129. Fire-Alarm Signal System; J. McFell, Chicago, Ill. App. filed Dec. 22, 1913. Especially for factories.

1,171,130. Synchronous Converter; S. H. Martin, Chicago, Ill. App. filed Aug. 22, 1912. Improved rotary transformer.

1,171,134. Dynamo - Electric Machine; A. H. Neuland, Bergenfield, N. J. App. filed March 4, 1914. Can be used as a speed-changing device as well as a motor-dynamo.

1,171,142. Ground Connection for Electrical Conductors; D. Rosen, Philadelphia, Pa. App. filed Feb. 10, 1915. Applicable to pipes.

1,171,151. Quick-Break Switch; P. Sorensen, New York, N. Y. App. filed June 26, 1914. Through-push-button type.

1,171,166. Lightning Arrester; L. S. Brach, New York, N. Y. App. filed April 3, 1911. Remains intact after usual discharges.

1,171,171. Adjustable Electric Lamp; R. D. Chandler, Spiceland, Ind. App. filed Sept. 21, 1914. Adjustable to a great variety of positions.

1,171,180. Electric-Lamp Socket; V. R. Despard, Chicago, Ill. App. filed May 27, 1914. Attachable to sheet-metal signs.

1,171,192. Explosion Indicator for Internal-Combustion Engines; C. T. Haas, Tucumcari, N. M. App. filed Sept. 16, 1915. Operated by exhaust gases.

1,171,193. Arc Lamp; C. A. B. Halvorson, Jr., Saugus, and J. T. Beechlyn, Lynn, Mass. App. filed April 3, 1912. Luminous-arc tye.

1,171,208. Voltage Regulation; L. B. Jones, Kansas City, Mo. App. filed Nov. 4, 1913. Compensates for temperature charges in the regulator itself.

1,171,213. Electrical Instrument; O. A. Knopp, Oakland, Cal. App. filed July 2, 1914. Applicable to alternating-current or direct-current systems.

1,171,254. Temperature-Regulating System; E. H. Ruckle, Chicago, Ill. App. filed March 25, 1915. For electric bake ovens and the like.

1,171,258. Electric Heater; S. Schneider, Berlin - Niederschonhausen, Germany. App. filed Feb. 6, 1914. Heat storage, mass construction, for ranges.

1,171,267. Insulator for Electrically Charged Wires; G. R. Smith, Arlington, Md. App. filed Jan. 4, 1915. Spring metal clip on insulator sleeve secures same in position.

1,171,271. Arc-Lamp Clutch; R. G. Standerwick, Lynn, Mass. App. filed Oct. 23, 1912 Improved mechanical structure.

1,171,272. Oil Switch; G. Stern, Berlin, Germany. App. filed July 21, 1913. Records danger due to explosive mixture above the oil.

1,171,279. Electrolytic Meter; J. N. Tuttle, Harwichport, Mass. App. filed March 27, 1914. Mercury anode.

1,171,291. System of Remote Control; J. D. Williamson, Jr., Philadelphia, Pa. App. filed Feb. 13, 1915. For rudder-operating motor

1,171,319. Automobile Signal; C. P. Carpenter and J. A. Bohl, Plainfield, N. J. App. filed July 16, 1915. Semaphores at opposite sides at rear of car.

1,171,338. Safety Device; H. G. Hillman, New York, N. Y. App. filed April 22, 1911. For elevators.

1,171,351. Apparatus for Transmitting Power; A. H. Neuland, San Francisco, Cal. App. filed March 22, 1913. Magnetically coupled shafts.

1,171,352. Dynamo-Electric Machine; A. H. Neuland, San Francisco, Cal. App. filed April 21, 1913. Small light commutator machine.

1,171,360. Process for the Production of Aluminum; H. F. D. Schwahn, Belleville, Ill, App. filed June 1, 1915. Aluminum sulphate subjected to hot carbon gases.

1,171,366. Motor; W. F. Straub and A. A. Radtke, Chicago, Ill. App. filed Feb. 11, 1913. For secondary clocks.

1,171,374. Starting Mechanism for Automobiles; C. E. Wilson, Wilkinsburg, Pa. App. filed Jan. 5, 1915. Armature for shifting gears into mesh.

1,171,375. Starting Mechanism for Automobiles; C. E. Wilson, Wilkinsburg, Pa. App. filed Jan. 5, 1915. Armature shifted longitudinally with force to bring gears into mesh.

1,171,379. Printing-Telegraph Receiver; J. E. Wright, Pittsburgh, Pa. App. filed July 24, 1914. Special "translator" construction.

1,171,399. Electrical System; L. W. Chubb, Pittsburgh, Pa. App. filed May 24, 1909. Impedance device and electric condenser.

14,060 (reissue). Attachment for Installing Magnetos on Gas Engines; W. G. Swift, Providence, R. I. App. filed April 22, 1915. (Original patent No. 1,107,174, Aug. 18, 1914.) Specially designed for "Ford" machines.